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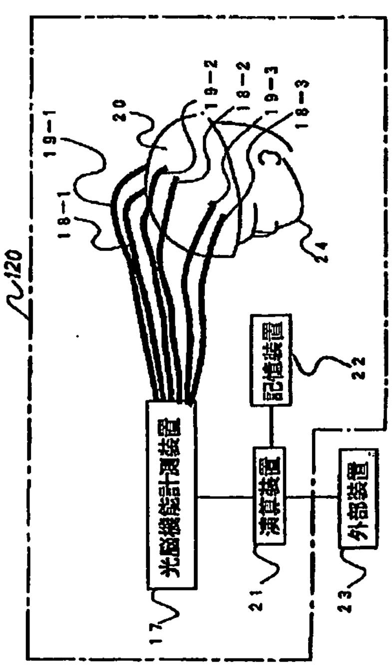
(54)【発明の名称】　光生体計測法を用いた生体入力装置および生体制御装置

(57)【要約】

【課題】局在化している脳機能を測定して、外部装置へ入力することにより、コンピュータ、ゲーム、環境制御装置、学習度判定装置、乗物の警報装置、医療用診断および警報装置、うそ発見器、意思表示装置、情報伝達装置等を制御する。

【解決手段】光脳機能計測装置１７により照射用光ファイバー１８－１，１８－２，１８－３と集光用光ファイバー１９－１，１９－２，１９－３を用いて、被検者６の頭部透過光強度を計測する。光脳機能計測装置１７により計測された各計測領域の頭部透過光強度は、演算装置２１に入力されると、演算装置２１では、前記各計測領域の頭部透過光強度と記憶装置２２に記憶された酸化及び還元ヘモグロビンの吸光係数および演算用のデータを用い、任意の出力信号を決定して外部装置２３に入力する。外部装置２３では、入力信号の種類に応じ動作する。



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【特許請求の範囲】

【請求項１】生体皮膚上に配置された少なくとも１つの光照射手段と、

該光照射手段より前記生体皮膚が照射されることにより、該生体皮膚の通過光を集光するため、該生体皮膚上に配置された少なくとも１つの集光手段と、

該集光手段により集光された生体通過光強度を計測する光生体計測用の光検出手段と、

出力信号の種類を決定するための参考データを記憶する記憶手段と、

前記光検出手段により計測された計測信号と該記憶手段に記憶されたデータとから出力信号の種類を決定する演算手段とを具備することを特徴とする光生体計測法を用いた生体入力装置。

【請求項２】生体皮膚上に配置された少なくとも１つの光照射手段と、

該光照射手段より前記生体皮膚が照射されることにより、該生体皮膚の通過光を集光するため、該生体皮膚上に配置された少なくとも１つの集光手段と、

該集光手段により集光された生体通過光強度を計測する光生体計測用の光検出手段と、

出力信号の種類を決定するための参考データを記憶する記憶手段と、

前記光検出手段により計測された計測信号と該記憶手段に記憶されたデータとから出力信号の種類を決定する演算手段とを備えた生体入力装置、および該生体入力装置で決定された出力信号を入力し、入力した信号の種類に応じて任意機能を動作する外部装置を具備することを特徴とする光生体計測法を用いた生体制御装置。

【請求項３】生体皮膚上に配置された少なくとも１つの光照射手段と、

該光照射手段より前記生体皮膚が照射されることにより、該生体皮膚の通過光を集光するため、該生体皮膚上に配置された少なくとも１つの集光手段と、

該集光手段により集光された生体通過光強度を計測する光生体計測用の光検出手段と、

演算されるべき任意時間間隔のヘモグロビン濃度変化率、ヘモグロビン濃度の時間変化の任意周波数における強度等を特徴パラメータの参考データとして予め設定し、これを記憶する記憶手段と、

前記光検出手段により計測された生体通過光強度より、脳内任意位置の脳内酸化ヘモグロビン濃度変化値または還元ヘモグロビン濃度変化値または総ヘモグロビン濃度変化値を演算し、該変化値から任意の特徴パラメータの値を演算し、該任意の特徴パラメータの値と前記記憶手段に記憶されたデータとから出力信号の種類を決定する演算手段とを備えた生体入力装置、および該生体入力装置で決定された出力信号を入力し、入力した信号の種類に応じて任意機能を動作する外部装置を具備することを特徴とする光生体計測法を用いた生体制御装置。

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【請求項４】請求項２または３に記載の光生体計測法を用いた生体制御装置において、

前記演算手段は、

各計測位置毎に計測される計測信号、あるいは脳内酸化ヘモグロビン濃度変化値または還元ヘモグロビン濃度変化値または総ヘモグロビン濃度変化値に関する各特徴パラメータ値を演算し、

前記演算された各特徴パラメータ値と記憶手段に記憶されている各特徴パラメータ毎に対して設定されている任意閾値と比較し、

前記各特徴パラメータ値毎の比較結果から出力信号の種類を決定する演算を行うことを特徴とする光生体計測法を用いた生体制御装置。

【請求項５】請求項２または３に記載の光生体計測法を用いた生体制御装置において、

前記演算手段は、

各計測位置毎に計測される計測信号、あるいは脳内酸化ヘモグロビン濃度変化値または還元ヘモグロビン濃度変化値または総ヘモグロビン濃度変化値に関する各特徴パラメータ値を演算し、

前記演算された各特徴パラメータ値と記憶手段に記憶されている各出力信号の種類毎に対応付けられた各特徴パラメータ毎に対する平均値と標準偏差値からなる学習データとから、各出力信号の種類毎にマハラノビス距離を演算し、

前記演算された各出力信号の種類毎のマハラノビス距離から最小となるマハラノビス距離を探索し、

かつ、前記探索した最小マハラノビス距離があらかじめ設定した閾値より小となる場合に、前記探索した最小マハラノビス距離と対応している出力信号の種類を出力信号の種類と決定する演算を行うことを特徴とする光生体計測法を用いた生体制御装置。

【請求項６】請求項２または３に記載の光生体計測法を用いた生体制御装置において、

前記演算手段は、

各計測位置毎に計測される計測信号、あるいは脳内酸化ヘモグロビン濃度変化値または還元ヘモグロビン濃度変化値または総ヘモグロビン濃度変化値に関する各特徴パラメータ値を演算し、

前記演算した各計測位置毎の各特徴パラメータ値を、前記演算した各計測位置毎の各特徴パラメータ値に対応して任意の出力信号の種類を決定するように学習したニューラルネットワークに入力し、出力信号の種類を決定する演算を行うことを特徴とする光生体計測法を用いた生体制御装置。

【請求項７】請求項２または３に記載の光生体計測法を用いた生体制御装置において、

前記特徴パラメータは、

任意計測時間中における脳内酸化ヘモグロビン濃度変化値あるいは還元ヘモグロビン濃度変化値あるいは総ヘモ

グロビン濃度変化値の積算値または、任意計測時間中における脳内酸化ヘモグロビン濃度変化値あるいは還元ヘモグロビン濃度変化値あるいは総ヘモグロビン濃度変化値の平均値または、任意計測時間中における脳内酸化ヘモグロビン濃度変化値あるいは還元ヘモグロビン濃度変化値あるいは総ヘモグロビン濃度変化値の任意周波数成分または、任意計測時間における脳内酸化ヘモグロビン濃度変化値または還元ヘモグロビン濃度変化値または総ヘモグロビン濃度変化値の変化率であることを特徴とする光生体計測法を用いた生体制御装置。

【請求項８】請求項２～７のいずれかに記載の光生体計測法を用いた生体制御装置において、

前記外部装置としてマイクロコンピュータを用い、被検体者である運転者の皮膚上に光照射手段と集光手段を配置し、生体入力装置で被検体者の居眠り状態を検出し、上記被検体者の居眠り状態を検出した際に生体入力装置より上記マイクロコンピュータに信号を入力し、

該マイクロコンピュータは上記信号が入力されたとき、警報を出力するか、あるいはブレーキを駆動させることを特徴とする光生体計測法を用いた生体制御装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、光生体計測法を用いた生体入力装置からの出力信号を外部装置へ入力することにより、種々の制御を行う制御装置に関し、詳しくはキーボード、マウス、ハンドルを用いずに装置を制御したり、居眠り警報装置を制御したり、環境装置を制御したり、学習度を判定したり、幼児や病人や動物等の感覚や思考を表示したり、うそを発見したりする光生体計測法を用いた生体入力装置および生体制御装置に関するものである。

【０００２】

【従来の技術】従来より、コンピュータやゲームなどの装置を動作するために、キーボードやマウスやハンドル等の種々な入力装置から制御している。しかし、このような人間が手足で操作する入力装置は、ゲームにおける臨場感を低減させたり、あるいは身体障害者等が操作することは困難である。そこで、脳波を用いて脳からの直接入力を行なう装置が特開平７－１２４３３１号公報で提案されている。この装置では、心電図を計測するときのように、脳波をそのまま計算機に入力することにより計算機、特にゲーム機を制御しようとしている。このような脳からの直接入力装置は、運動機能に障害が認められる患者の外部装置の制御が可能であり、身体障害者の社会参加への貢献も期待されている。

【０００３】

【発明が解決しようとする課題】ところで人間の脳は、ブロードマンの脳地図で表されるように、異なる細胞構築で領域分割されており、さらに、各領域は異なる機能を分担している。例えば、脳を横から見ると、自発的な運動（手、指、足等）に関与する領域は頂上部、感覚、視覚等に関与する領域は後頭部、言語に関与する領域は左半分の所定部で、それぞれ分担している。このように特定された場所からの情報を高精度で抽出するためには、空間分解能の高い計測装置を用いる必要がある。しかし、従来技術において用いられる脳波は、生体中では誘電率が不均一なために信号の発生場所が不明確となるので、空間分解能が低い。また、被検体が動くことによる筋電位が信号に大きく反映し、これにより脳波検出に悪影響を及ぼすため、測定時には被検体を拘束しなければならないという制約条件もあり、非常に実用性に欠けていた。従って、脳からの入力信号として、脳波を直接用いる方法は精度および実用性において問題がある。本発明の目的は、このような従来の課題を解決し、空間分解能が高い生体計測信号を入力信号として用いることにより、精度および実用性の高い生体計測方法を用いた生体入力装置および生体制御装置を提供することにある。

【０００４】

【課題を解決するための手段】上記目的を達成するため、本発明による光生体計測法を用いた生体入力装置は、生体皮膚上に配置された少なくとも１つの光照射手段と、該光照射手段より前記生体皮膚が照射されることにより、該生体皮膚の通過光を集光するため、該生体皮膚上に配置された少なくとも１つの集光手段と、該集光手段により集光された生体通過光強度を計測する生体計測用の光検出手段と、演算されるべき任意時間間隔のヘモグロビン濃度変化率、ヘモグロビン濃度の時間変化の任意周波数における強度等を特徴パラメータの参考データとして予め設定し、これを記憶する記憶手段と、前記光検出手段により計測された計測信号、あるいは生体通過光強度より、脳内任意位置の脳内酸化ヘモグロビン濃度変化値または還元ヘモグロビン濃度変化値または総ヘモグロビン濃度変化値を演算し、該変化値から任意の特徴パラメータの値を演算し、該任意の特徴パラメータの値と前記記憶手段に記憶されたデータとから出力信号の種類を決定する演算手段とを具備することを特徴としている。また、本発明による光生体計測法を用いた生体制御装置は、上記生体入力装置により決定された出力信号を入力し、入力した信号の種類に応じて任意機能を動作する外部装置とを具備することを特徴としている。ここで、光照射手段および集光手段の配置により集光される光は、反射光および透過光に分類されるが、本発明では両者を含めて全て通過光とする。

【０００５】

【発明の実施の形態】本発明においては、光を用いて局在化している脳機能活動を計測し、計測された信号を計算機あるいは外部装置への入力信号として用いる。すなわち、１以上の照射用光ファイバーと１以上の集光用光ファイバーとを頭部の１以上の計測領域（例えば、右手指運動野、左手指運動野、言語野等）に設定し、被検者

の頭部通過光を集光することにより、それぞれ計測された信号を演算装置に入力する。演算装置では、計測信号自体から例えば右手指運動の入力に対してはカーソルを左側に移動、左手指運動の入力に対してはカーソルを右側に移動、言語野の入力に対してはクリックを行う、等の出力信号の種類を決定し、出力信号をコンピュータ、ワードプロセッサ、あるいはゲーム機等の外部装置に入力する。外部装置は入力信号の種類に応じた動作を行う。演算装置の他の方法では、計測した通過光強度より脳内酸化ヘモグロビン濃度変化値、または還元ヘモグロビン濃度変化値、または総ヘモグロビン濃度変化値を演算し、これらの値から特徴パラメータ値を演算して、記憶装置に記憶された特徴パラメータ値と演算した特徴パラメータ値とを比較することにより、出力信号の種類を決定し、出力信号を外部装置に入力する。さらに、他の計測方法として、外部装置の入力信号を各計測領域に対応させずに、『カーソルを右に、』，『カーソルを左に、』，『クリックを行う』等を被検者に想像させ、その時の各計測領域毎の各特徴パラメータ毎の標準偏差値および平均値を記憶装置に学習データとして記憶しておき、実際の計測値とそれらの学習データとを比較して、許容範囲内で一致すれば出力信号とする。この方法で、特徴パラメータを用いて出力信号の種類を決定するために、マハラノビス距離を利用することができる他、ニューラルネットワークを利用することもできる。ここで、マハラノビス距離とは、計測値等が分散を有する正規分布で表現される場合に、実際の計測値がその分布に属するか否かを判定する指標である。これにより、キーボードやマウス等を用いずにコンピュータ、ワードプロセッサ、あるいはゲーム機等を制御することができるので、障害者用としても利用できる。さらに、被検体に多数点の照射光手段と集光手段を配置することにより、運転者の居眠り警報装置、環境制御装置、学習度判定装置、病人や幼児や動物等の意思表示装置、情報伝達装置、あるいはうそ発見器等にも適用することができる。

【０００６】

【実施例】以下、本発明の動作原理および実施例を、図面により詳細に説明する。図１は、光を用いて局在化している脳機能活動を計測する装置（以降、光脳機能計測装置と略す）の概略構成図である。本発明においては、局在化している脳機能活動を光を用いて計測し、計測された信号を計算機への入力信号とする。ここでは、生体中の酸化及び還元ヘモグロビン濃度変化計測を目的とし、照射波長に２波長用いることにより、酸化ヘモグロビン濃度変化、還元ヘモグロビン濃度変化を、それぞれ独立して計測する。すなわち、光の吸収により酸化ヘモグロビン濃度と還元ヘモクロビン濃度を、色の違いにより計測するのである。波長をさらに増加すれば、精度が向上するとともに、酸化および還元ヘモグロビン以外の物質濃度の計測が可能である。ここでは、光照射位置及び光検出位置を１カ所設定した場合について説明するが、それぞれ数を増やすことは容易である。特定波長の光が、光源１－１及び１－２より発せられ、それぞれ光ファイバー２－１及び２－２に入射される。ここで、光源１－１からの波長はλ１であり、光源１－２からの波長λ２で、４００ｎｍから２４００ｎｍの範囲から選択する。特に、生体中の血行動態を計測する場合に、７００ｎｍから１１００ｎｍの範囲から、波長差が５０ｎｍ以内となるように選択することが、精度を上げるために望ましい。つまり、この波長帯では光の透過性が高い。これ以上の波長では、水の結晶も大きくなり、またこれ以下では、ヘモグロビン血液自体の吸収も大きくなるので都合が悪い。また、光源１－１及び１－２は、それぞれ駆動回路４－１及び４－２により異なる周波数ｆ１及びｆ２で強度変調されている。各駆動回路４－１及び４－２からの周波数信号は参照周波数信号として、それぞれ、位相検波器９－１及び９－２に入力されている。これは、酸化及び還元ヘモグロビン濃度変化値が混合された波長から、酸化と還元ヘモグロビン濃度値を別々に取り出すためである。

【０００７】光ファイバー２－１及び２－２は光方向性結合器３と接続しており、光源１－１及び１－２からの光は混合され照射用光ファイバー５に入射される。照射用光ファイバー５から被検者６の頭皮上より光を照射し、集光用光ファイバー７で生体通過光を集光する。これにより、血液中を流れる酸化および還元ヘモグロビン濃度の違による色の違いを計測する。動脈では酸素飽和度（全ヘモグロビン中の酸化ヘモグロビンの占める割合）が高いが、静脈では動脈と比較して酸素飽和度が低下している。ここで、照射用光ファイバー５と集光用光ファイバー７間の距離は、計測位置により１０～５０ｍｍの距離とするが、本装置構成では３０ｍｍとしている。集光用光ファイバー７で集光された生体通過光は、それぞれ光検出器８に入射され、各集光位置における生体通過光が光電変換及び増幅される。光検出器８には、光電子増倍管やアバランシェフォトダイオードが用いられる。光検出器８からの出力信号は、２分配された後に位相検波器９－１及び９－２に入力される。各位相検波器９－１，９－２に入力した信号には、照射した２波長の生体通過光が混合しているが、各位相検波器９－１及び９－２にはそれぞれ駆動回路４－１及び４－２から参照周波数が入力されているので、位相検波器９－１では光源１－１からの生体通過光強度を、位相検波器９－２では光源１－２からの生体通過光強度を分離検出することができる。

【０００８】位相検波器９－１及び９－２で検出した生体通過光強度信号を、各々アナログーデジタル変換器（以降Ａ／Ｄ変換器と略す）１０－１及び１０－２に入力し、デジタル信号に変換した後、演算装置１１に取り込む。演算装置１１では、取り込まれた２波長の通過光

強度の時系列信号より、酸化ヘモグロビン濃度及び還元ヘモグロビン濃度及び血液量を表す酸化ヘモグロビン濃度と還元ヘモグロビン濃度の和を演算し、時系列グラフとして表示装置１２に表示する。血液中のヘモグロビンの量（体積）は一定であり、酸化ヘモグロビンと還元ヘモグロビンを単に加えれば、全体の血液量がわかる。本装置構成により、脳機能活動に伴う酸化ヘモグロビン及び還元ヘモグロビン及び総ヘモグロビン濃度変化を演算する方法が、例えば、本出願人により特願平７－３０９７２号明細書および図面で提案されている（演算処理方法）。なお、ここでは、ヘモグロビン濃度が変化した量だけを演算しているが、生体中の散乱を除く演算を行えば濃度の絶対量も計測できる。

【０００９】図２は、光脳機能計測装置による右手指運動時のヘモグロビン濃度変化を示す図である。ここでは、本装置を用い、右手指の動きに関与する脳内の領域（以降、右手指運動野と略す）を計測領域とし、右手指運動を行った場合の酸化ヘモグロビン１４－１及び還元ヘモグロビン１４－２及び総ヘモグロビン濃度変化１４－３の時間変化を示している。なお、１３は右手指運動期間である。図３は、光脳機能計測装置による左手指運動時のヘモグロビン濃度変化を示す図である。ここでは、本装置を用い、左手指運動野を計測領域とし、左手指運動を行った場合の酸化ヘモグロビン１６－１及び還元ヘモグロビン１６－２及び総ヘモグロビン濃度変化１６－３の時間変化を示している。なお、１５は左手指運動期間である。図２及び図３を比較すると明らかなように、右手指運動期間１３中の右手指運動野での酸化ヘモグロビン濃度変化１４－１及び総ヘモグロビン濃度変化１４－３は、左手指運動期間１５中の左手指運動野での酸化ヘモグロビン濃度変化１６－１及び総ヘモグロビン濃度変化１６－３の約３倍の変化量を示している。なお、脳の左側にある運動野は、右半身に関係する運動領域であって、脳内領域と関与する身体部分は互いにクロス関係になっている。また、還元ヘモグロビンは、それほど顕著に変動はしない。

【００１０】図４は、光脳機能計測装置による右手指運動時の総ヘモグロビン濃度変化の等高線グラフを示す図である。ここでは、本装置を用い、右手指運動野を包含するように多点で計測を行い、右手指運動を行った場合の総ヘモグロビン濃度変化の等高線グラフを示す。図４では、図４の上下方向が脳の上下を、左側が脳の前側、右側が脳の後側を示している。図４より、このような顕著な変化を示す局所的な部位が光脳機能計測装置によって計測されていることがわかる。図５は、光脳機能装置による言語想起時の総ヘモグロビン濃度変化の等高線グラフを示す図である。ここでは、言語活動に関与する領域（以降、言語野と略す）を包含する様に多点で計測を行い、言葉を想起した場合の酸化ヘモグロビン濃度変化の等高線グラフを示している。言語野は、左側頭部脳内のこめかみの近傍の位置に存在する。この場合にも、顕著な変化を示す局所的な部位が光脳機能計測装置によって計測されている。光脳機能計測装置は、このように、想起による脳機能活動も計測することが可能である。従って、本発明においては、光脳機能計測装置によって計測した信号を外部装置への入力信号として用いることにより、精度及び実用性が高い脳からの直接入力方法を実現することができる。

【００１１】以上で発明の原理の概要を述べたので、以下では、本発明の実施例を述べる。図６は、本発明の一実施例を示す光脳機能計測装置の構成図である。図６において、１２０は生体入力装置であり、２３は外部装置であり、これら生体入力装置１２０と外部装置２３とで生体制御装置が構成される。光脳機能計測装置１７及び照射用光ファイバー１８－１及び１８－２及び１８－３と集光用光ファイバー１９－１及び１９－２及び１９－３を用いて、被検者６の頭部透過光強度を計測する。照射用光ファイバー１８－１及び集光用光ファイバー１９－１は計測領域１に、照射用光ファイバー１８－２及び集光用光ファイバー１９－２は計測領域２に、照射用光ファイバー１８－３及び集光用光ファイバー１９－３は計測領域３に、それぞれ光ファイバー固定ヘルメット２０によって固定されている。ここで、計測領域数を増やすことは容易であり、また、各計測領域において、空間分解能を向上するために複数の光ファイバーを配置することも容易である。光脳機能計測装置により計測された各計測領域の頭部通過光強度は、演算装置２１に入力される。演算装置２１では、前記各計測領域の頭部通過光強度と記憶装置２２に記憶された酸化及び還元ヘモグロビンの吸光係数及び演算用のデータを用い、後述する演算方法により、任意の信号を特定して外部装置２３に入力する。予め記憶装置２２には、その信号がどのような意味を持つのかを判定するために、それまでに学習した結果（ヘモクロビンの吸光係数や演算用データ）を記憶しておく。外部装置２３では、前記入力された任意信号の種類に応じて動作する。外部装置２３としては、コンピュータ、ワードプロセッサ、ゲーム機、あるいは通信装置等を用いることができる。

【００１２】次に、図６における演算装置２１における演算方法について説明する。図７は、図６における演算装置の手順を示すフローチャートである。例えば、照射用光ファイバー１８－１及び集光用光ファイバー１９－１を左手指運動野（計測領域１）に設定し、照射用光ファイバー１８－２及び集光用光ファイバー１９－２を右手指運動野（計測領域２）に設定し、照射用光ファイバー１８－３及び集光用光ファイバー１９－３を言語野（計測領域３）に設定し、各計測領域における生体通過光強度が演算装置２０に入力される。

（ｓｔｅｐ１－１）計測領域１－１からの各波長の通過光強度から、酸化または還元または総ヘモグロビン濃度

を演算する。

（ｓｔｅｐ１－２）ｓｔｅｐ１－１で演算された各または任意のヘモグロビン濃度、つまり酸化、還元および総ヘモグロビン濃度、またはそれらの中の１つの濃度より、特徴パラメータを演算する。特徴パラメータとしては、例えば任意時間間隔の各または任意のヘモグロビン濃度の積算値や、任意時間の各または任意のヘモグロビン濃度の変化率や、各または任意のヘモグロビン濃度の時間変化の任意周波数の強度が用いられ、これは様々に決定することができる。

（ｓｔｅｐ１－３）ｓｔｅｐ１－２で演算された特徴パラメータを記憶装置２２内の学習値と比較することにより、特徴パラメータ値あらかじめ設定してある任意の閾値範囲内にあるか否かを判断し、範囲内であれば信号１を出力する。また、範囲外であれば、ｓｔｅｐ１－４に進む。

【００１３】（ｓｔｅｐ１－４）計測領域２からの各波長の通過光強度から、酸化または還元または総ヘモグロビン濃度を演算する。

（ｓｔｅｐ１－５）ｓｔｅｐ１－４で演算された各または任意のヘモグロビン濃度より、特徴パラメータを演算する。特徴パラメータとしては、例えば任意時間間隔の各または任意のヘモグロビン濃度の積算値や、任意時間の各または任意のヘモグロビン濃度の変化率や、各または任意のヘモグロビン濃度の時間変化の任意周波数における強度が用いられ、これは様々に決定することができる。

（ｓｔｅｐ１－６）ｓｔｅｐ１－５で演算された特徴パラメータが、あらかじめ設定してある任意の閾値範囲内にあるか否かを判断し、範囲内であれば信号２を出力する。また、範囲外であればｓｔｅｐ１－７に進む。

（ｓｔｅｐ１－７）計測領域３からの各波長の通過光強度から、酸化または還元または総ヘモグロビン濃度を演算する。

（ｓｔｅｐ１－８）ｓｔｅｐ１－７で演算された各または任意のヘモグロビン濃度より、特徴パラメータを演算する。特徴パラメータとしては、例えば任意時間間隔の各または任意のヘモグロビン濃度の積算値、あるいは平均値や任意時間の各または任意のヘモグロビン濃度の変化率や、各または任意のヘモグロビン濃度の時間変化の任意周波数における強度が用いられ、これは様々に決定することができる。

（ｓｔｅｐ１－９）ｓｔｅｐ１－８で演算された特徴パラメータが、あらかじめ設定してある任意の閾値範囲内にあるか否かを判断して、範囲内であれば信号１を出力する。また範囲外であれば、ｓｔｅｐ１－１に戻る。

【００１４】ここで、外部装置２３がコンピュータであることを想定し、常に外部装置２３を入力待ち状態にしておく。さらに、信号１の入力に対してカーソルが左、信号２の入力に対してカーソルが右、信号３の入力に対してクリックというように、予め信号に対する外部装置の機能をあらかじめ対応させておくことも可能である。また、この演算方法の拡張としては、ｓｔｅｐ１－３及びｓｔｅｐ１－６及びｓｔｅｐ１－９において、閾値範囲内の場合には０，閾値範囲外の場合には１を出力する様にしておけば、演算装置２１から出力する信号として８通りの組合せを作ることができる（０００～１１１）。この場合には、信号１から信号８までの出力を行い、各信号に対応した外部装置２３の任意機能動作をあらかじめ決めておけばよい。このように、演算第１例では、予め右手指運動野、左手指運動野、および言語野を定め、その場所毎に信号を計測する場合であって、信号と機能動作を１対１に対応させる場合を述べた。

【００１５】図８は、図６における演算装置の第２の演算手順例を示すフローチャートである。演算方法の第２例では、各計測領域において計測される酸化または還元または総ヘモグロビン濃度変化と、外部装置２３に入力する信号を１対１に対応させない場合である。例えば、演算方法第１例の場合には、場所毎にねらって信号を取り出し、特定信号を機能動作に対応させた方法である。しかし、使用者がカーソルを左に動かしたい意志を有した場合に、左手を動かすことを想起しなければならず、実際の外部装置の機能と使用者の想起がかけ離れたものとなってしまう。これに対して、本演算方法の第２例では、前記問題点を考慮した方法である。まず、計測領域をｉ箇所設定し、それぞれの計測領域に照射用光ファイバー及び集光用光ファイバーを配置し、各計測領域における生体通過光強度が演算装置２１に入力される。すなわち、第２例では、場所毎にねらって特定の信号を計測するのではなく、具体的に場所を特定せずに光ファイバを頭部に接続し、コンピュータに入力する動作を想起した時の光脳機能計測を行い、これを何回か行って学習し、その結果を予め記憶装置２２に記憶しておくのである。そして、実際に計測された信号から濃度を演算し、特徴パラメータを演算して、これを記憶装置２２のデータの中に同じような特徴パラメータが存在するか否かを探索する。以下、図８のフローに沿って説明する。

【００１６】（ｓｔｅｐ２－１）各計測領域ｉ毎からの各波長の通過光強度から、酸化または還元または総ヘモグロビン濃度を演算する。

（ｓｔｅｐ２－２）ｓｔｅｐ２－１で演算された各または任意のヘモグロビン濃度より、各計測領域ｉ毎の各特徴パラメータｊの値Ｐｉ，ｊ（マトリクス値）を演算する。ここで、特徴パラメータとしては、例えば任意時間間隔の各または任意のヘモグロビン濃度の積算値や、任意時間の各または任意のヘモグロビン濃度の変化率や、各または任意のヘモグロビン濃度の時間変化の任意周波数における強度が用いられ、これは様々に決定することができる。

（ｓｔｅｐ２－３）ここで、演算装置２１より出力され

る信号の種類をｋ種類とする。あらかじめ記憶装置２２には、一般的あるいは使用者個人の学習データが記憶されている。学習データ構造は、各出力信号ｋ毎に同じ構造を持つ各計測領域ｉ毎の各特徴パラメータｊ毎の標準偏差値及び平均値である。すなわち、特徴パラメータの確率分散がガウシャン分布であることを前提としている。標準偏差値及び平均値で、ガウス関数を記述することができる。例えば、外部装置２３をコンピュータと想定し、前記コンピュータにあらかじめ演算装置２１からの信号ｋが入力された場合、カーソルが右に動くように設定しておく。また、使用者はあらかじめ光脳機能計測装置１７を装着し、”カーソルを右に動かす”と想起することを複数回行う。この時、計測される各計測領域ｉ毎の各特徴パラメータｊ毎に標準偏差値および平均値を計算する。ここで得られた、各計測領域ｉ毎の各特徴パラメータｊ毎の標準偏差値および平均値を、信号ｋの学習データとして記憶装置２２に記憶する。このｓｔｅｐ２－３では、前記記憶されている学習データＤｉ，ｊ，ｋを読み込む。図９は、この学習データＤｉ，ｊ，ｋのデータ構造を示す図である。図９において、Ｓは標準偏差値を表し、Ａは平均値を表し、点線は省略を意味する。また、計測領域ｉをｎ箇所とし、特徴パラメータｊの種類数はｍ種類としている。

【００１７】（ｓｔｅｐ２－４）記憶されている全学習データＤｉ，ｊ，ｋとｓｔｅｐ２－２演算された各計測領域ｉ毎の各特徴パラメータｊの値Ｐｉ，ｊを用い、各信号ｋ毎にマハラノビス距離ＭＤｋを演算する。マハラノビス距離は、周知の簡単な式で表わされる。

（ｓｔｅｐ２－５）ｓｔｅｐ２－４で演算された各信号ｋ毎のマハラノビス距離ＭＤｋから、最小のマハラノビス距離ＭＤｋを探索する。１～ｋ個の信号中の最小の値を選択すれば、それが最小のマハラノビス距離となる。

（ｓｔｅｐ２－６）最小のマハラノビス距離ＭＤｋが任意の閾値範囲内にあるか否かを判断する。範囲内にある場合には、ｓｔｅｐ２－７に進む。また範囲外にある場合には、ｓｔｅｐ２－１へ戻る。

（ｓｔｅｐ２－７）信号ｋを出力する。

【００１８】第２例の演算方法は、マハラノビス推定方法を応用したものであるが、同様な推定を行うために、第３の演算方法としてニューラルネットワークを応用する方法もある。この場合には、ニューラルネットワーク入力側各端子に、各計測領域ｉ毎の各特徴パラメータｊを入力するようにし、出力側各端子に各信号ｋ（ｋ＝１～ｌ）を割り当てる。ニューラルネットワークは、あらかじめ各計測領域ｉ毎の各特徴パラメータｊの値によって、任意の信号ｋを出力するように各使用者毎あるいは一般的な使用者の複数回の使用によって学習しておく。この学習したニューラルネットワークを用いることで、図８に示したマハラノビス推定と同様に機能し、使用者が想起したことに対応した信号を出力することができる。図６では、演算装置２１の後段にニューラルネットワークを接続し、特徴パラメータをネットワークの入力側各端子に入力する。ネットワークの出力側各端子に、外部装置２３を接続する。なお、第１例，第２例および第３例の演算方法の他に、演算装置は、光脳機能計測用の検出器により計測された信号を直接用いて、出力信号の種類を決定することも、勿論可能である。

【００１９】図１０は、本発明の他の実施例を示す生体制御装置のブロック図である。図１０において、１０１は運転者、１０２はハンドル、１０３は座席、１０４は自動車、１０５は駆動回路、１０６はスピーカー、１０７は光ファイバー固定具あるいは光ファイバー固定ヘルメット、１０８は光照射用光ファイバー、１０９は光集光用光ファイバー、１１０は入力装置、１１１は生体光計測部、１１２は入力信号判定部、１１３は信号線、１１４はマイクロコンピュータ、１１５は記憶装置である。本実施例は、生体制御装置を自動車運転時の居眠り警報装置として適用した場合を示す。すなわち、入力装置１１０（生体計測部１１１と入力信号判定部１１２と光照射用光ファイバー１０８と光集光用光ファイバー１０９と光ファイバー固定具あるいは光ファイバー固定ヘルメット１０７）が生体入力装置を構成しており、外部装置としてマイクロコンピュータ１１４を用いている。運転者１０１が座席１０３に座りハンドル１０２を操作して自動車１０４を運転している状態を示している。運転者１０１は、光ファイバー固定具あるいは光ファイバー固定ヘルメット１０７を着用している。光ファイバー固定具あるいは光ファイバー固定ヘルメット１０７には、１組以上の光照射用光ファイバー１０８と光集光用光ファイバー１０９が固定されている。光照射用光ファイバー１０８からは常時、運転者１０１の頭部に光が照射され、任意の距離（例えば３０mm程度）離れて固定されている光集光用光ファイバー１０９で生体通過光が集光されている。光照射用光ファイバー１０８から照射する光の光源は、入力装置１１０内部にある生体光計測部１１１にあり、また光集光用光ファイバー１０９で集光された光を検出する光検出器も同様に生体光計測部１１１にある。

【００２０】ここで、図６に示した実施例に示したように、異なる光照射位置毎および異なる波長毎に照射する光強度に異なる強度変調周波数を与え、光検出器で検出され電気信号に変換された生体通過光強度を位相検波して計測すれば、迷光の影響を除去し、各計測位置毎の各波長毎の生体通過光強度を計測することが可能である。１組の光照射用光ファイバー１０８と光集光用光ファイバー１０９で定義される計測位置は、運転者１０１毎に任意複数設定して差し支えないが、生体透過性の高い前頭部や、また眠気によって顕著に血行動態が変化する特徴的な部位が予めわかっている場合には、前記特徴的な部位に設定する。生体光計測部１１１で計測された頭部

血行動態を表す計測信号を元に、入力信号判定部１１２において眠気の信号を抽出する。ここで、入力信号判定部１１２は、ヘモグロビン等の光学パラメータ等血行動態演算に必要な定数データと運転者１０１に関する学習データが記憶されている記憶装置と、血行動態の演算と入力信号の判定を行う演算装置とで構成されている。また、第３の演算手順例で示したように、入力信号の判定にニューラルネットワークを用いることも可能である。ここで、入力信号判定部１１２で運転者１０１の眠気が検出された場合には、入力装置１１０より信号線１１３を用いてマイコン１１４に入し、マイコン１１４から駆動回路１０５とスピーカー１０６からなる居眠り警報装置に信号を出力する。居眠り警報装置は、信号が入力されたならば、スピーカー１０６に警告の音声を発するように機能する。ここで、居眠り警報装置１０５の機能としては、音声で運転者を刺激するほかに、光で刺激あるいは座席を振動させる等、種々の方法で刺激することが考えられる。また、マイコン１１４から警報のレベルに応じて記憶装置１１５に記憶された音声データを選択して、『危険、危険、・・・』という意味を有する音声情報を出力することもできる。また、入力装置１１０を光ファイバー固定具１０７に内装し、信号線１１３を用いずに電磁波によって居眠り警報装置に信号を入力することも可能である。さらに、警報レベルが上ったことをマイコン１１４が判断した場合には、マイコン１１４から下方の矢印に信号伝達することにより、ブレーキをかけたり、エンジンを停止する信号を出力することもできる構成としている。

【００２１】警報装置としては、図１０の自動車のみならず、飛行機、電車等の全ての移動手段にも適用することができ、これらの移動手段の運転中に、眠気、疲労、いらいら感、レッドアウト、ブラックアウト等、運転に支障をきたす感覚を判定して警報を与える装置として応用することができる。なお、レッドアウト、ブラックアウトとは、飛行機等の操縦中に大きな加速度により脳内血流が局所に集中し、視覚異常あるいは意識の喪失を引き起す症状である。このように、生体入力装置をマイコンの入力装置として用いると、例えば環境制御装置としても適用できる。すなわち、寒い、熱い、リラックス感等、主観的な感覚を判定して、環境温度、環境音楽、明るさ、映像等の環境をコントロールすることができる装置として利用することができる。また、学習度判定装置としても適用することができる。すなわち、学問、運動（リハビリも含む）等の学習の程度を判定し、その習熟度を表示する装置として使用できる。表示された習熟度に基づいて、被験者が繰り返し訓練を行う訓練装置として用いることもできる。また、医療用診断および警報装置としても適用できる。すなわち、てんかん焦点決定のための診断装置、脳疾患患者の脳機能検査の装置、てんかん発作の警報装置等に適用することができる。また、筋疾患や植物状態の患者、幼児、および動物等から外部に意思を伝達できないか、意思が通じないものの感覚や思考を表示する装置としても適用することができる。より具体的に示すと、幼児が思っていることを生体入力装置でとらえ、それをディジタルの電気信号に変えてマイコンに入力し、予めメモリに意味を持っている言葉を登録しておき、それを選択判定し、音声で出力する。また、幼児の脳からの情報を生体入力装置でとらえ、刻々の脳の変化を検出し、それを音素として音声合成回路に入力し、幼児が思っていることを話し声として意志を伝達させることができるものである。さらに、動物、ペット等の動物に取り付けることにより、何を欲しがっているのかも知ることができる。また、喜怒哀楽等の感情を判定し、テレビ電話等で感情情報を伝達する装置にも適用することができる。この装置により伝達される感情情報から、受手側に表示される顔のコンピュータグラフィックスの表情を生成することができる。また、集中力を判定し、これを表示する装置にも適用することができる。さらに、うそ発見器としても適用することができる。

【００２２】

【発明の効果】以上説明したように、本発明によれば、局在化している脳機能を、光脳機能計測装置によって計測し、計測信号を外部装置への入力信号として用いるので、キーボードやマウスやハンドルを用いずに外部装置を制御することができる他に、乗物の警報装置、環境制御装置、学習度判定装置、医療用診断および警報装置、意思表示装置、情報伝達装置、集中力判定装置およびうそ発見器等にも適用することができる。従って、従来はできなかった情報不伝達物との交信が可能となる。

【図面の簡単な説明】

【図１】本発明の一実施例を示す光脳機能計測装置の構成図である。

【図２】光脳機能装置による右手指運動時のヘモグロビン濃度変化を示す図である。

【図３】光脳機能装置による左手指運動時のヘモグロビン濃度変化を示す図である。

【図４】光脳機能装置による右手指運動時の総ヘモグロビン濃度変化の等高線グラフを示す図である。

【図５】光脳機能装置による言語想起時の総ヘモグロビン濃度変化の等高線グラフを示す図である。

【図６】本発明の具体的装置構成図である。

【図７】図６における演算装置の演算手順を示すフローチャートである。

【図８】図６における演算装置の他の演算手順を示すフローチャートである。

【図９】図６の記憶装置に記憶している学習データ構造の図である。

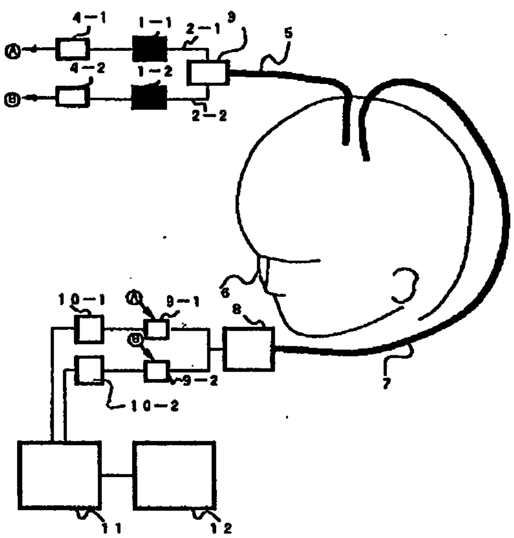
【図１０】本発明に基づく生体入力装置を、外部装置である自動車運転時の居眠り警報装置に適用した場合の構

成図である。

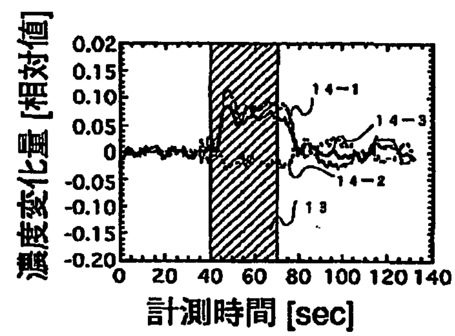
【符号の説明】

１－１，１－２：光源，２－１，２－２：光ファイバー，３：光方向性結合器，４－１，４－２：光源駆動装置，５：照射用光ファイバー，６：被検者，７：集光用光ファイバー，８：光検出器，９－１：位相検波器，９－２：位相検波器，１０－１：アナログーデジタル変換器，１０－２：アナログーデジタル変換器，１１：演算装置，１２：表示装置，１３：右手指運動期間，１４－１：酸化ヘモグロビン濃度変化，１４－２：還元ヘモグロビン濃度，１４－３：総ヘモグロビン濃度，１５：左手指運動期間，１６－１：酸化ヘモグロビン濃度変化，１６－２：還元ヘモグロビン濃度，１６－３：総ヘモグ＊ロビン濃度，１７：光脳機能計測装置，２０：光ファイバー固定ヘルメット，１８－１，１８－２，１８－３：照射用光ファイバー，２１：演算装置，１９－１，１９－２，１９－３：集光用光ファイバー，２２：記憶装置，２３：外部装置，２４：使用者，１０１：運転者，１０２：ハンドル，１０４：自動車，１０６：スピーカー，１１１：光生体計測部、１１２：入力信号判定部，１１４：マイクロコンピュータ（マイコン）１１３：信号線，１１０，１２０：生体入力装置，１０３：座席，１０５：居眠り警報装置，１０８：光照射用光ファイバー，１０７：光ファイバー固定具あるいは光ファイバー固定ヘルメット，１０９：光集光用光ファイバー。

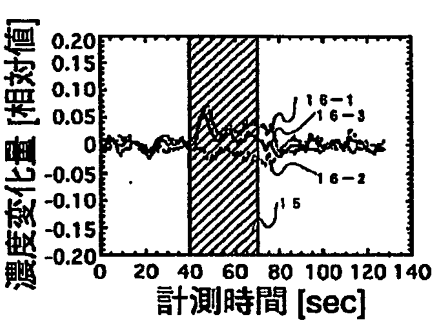
【図１】



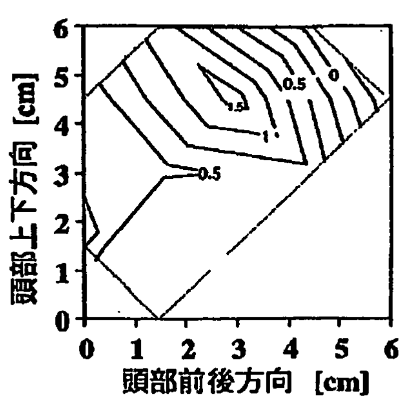
【図２】



【図３】



【図４】



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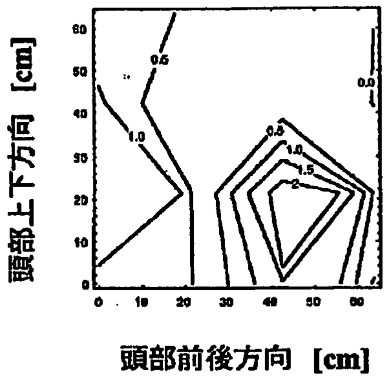
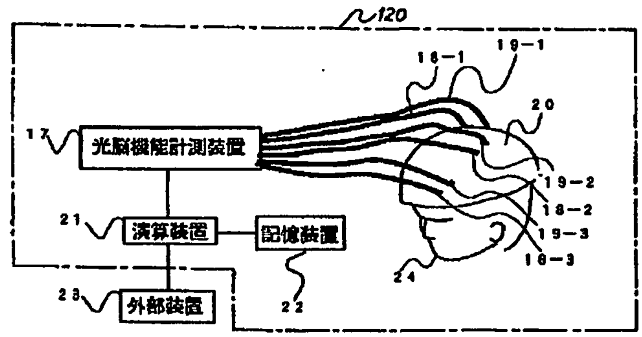
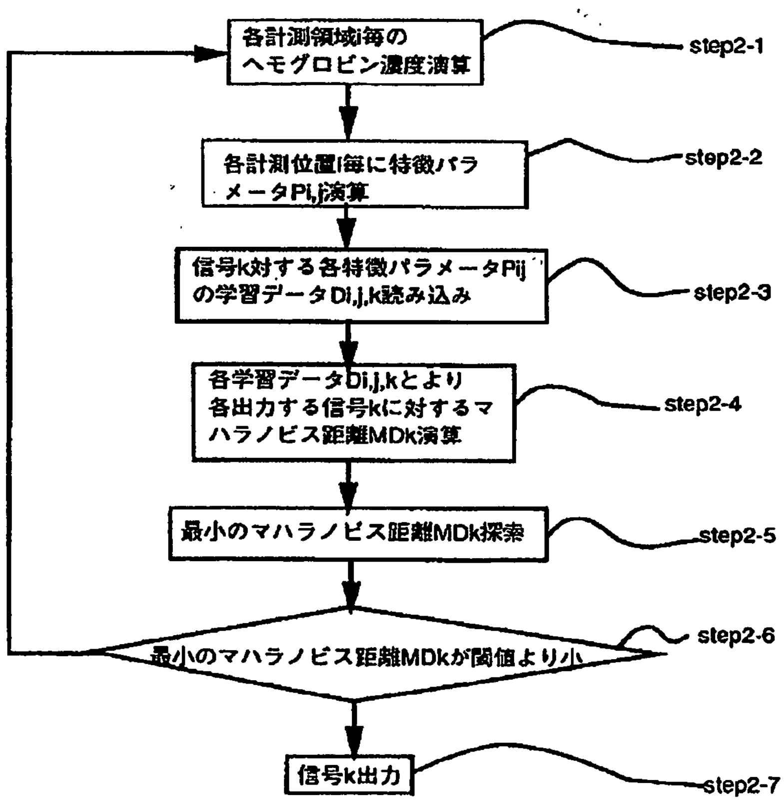

頭部上下方向 [cm]
頭部前後方向 [cm]
0.5
1.0
0.0
1.5
2

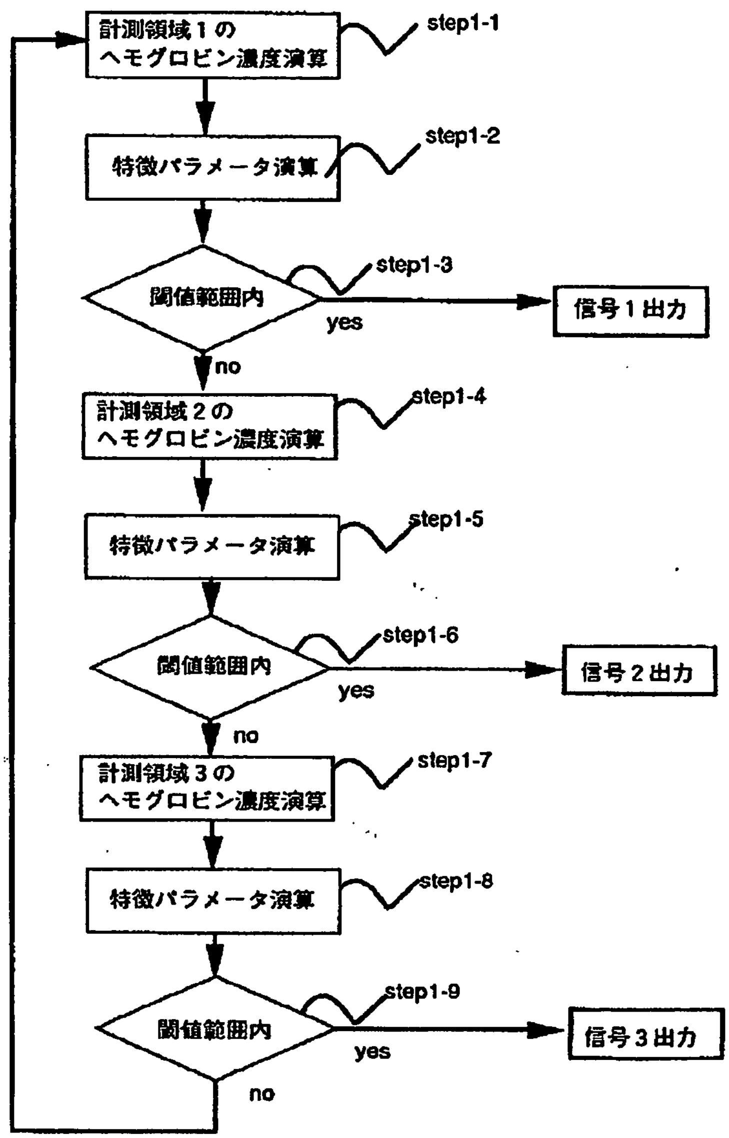
【図6】


120
17
光脳機能計測装置
21
演算装置
記憶装置
22
23
外部装置
18−1
19−1
20
19−2
18−2
19−3
18−3
24

【図8】


各計測領域i毎の
ヘモグロビン濃度演算
step2-1
各計測位置i毎に特徴パラ
メータPi,j演算
step2-2
信号k対する各特徴パラメータPij
の学習データDi,j,k読み込み
step2-3
各学習データDi,j,kとより
各出力する信号kに対するマ
ハラノビス距離MDk演算
step2-4
最小のマハラノビス距離MDk探索
step2-5
最小のマハラノビス距離MDkが閾値より小
step2-6
信号k出力
step2-7

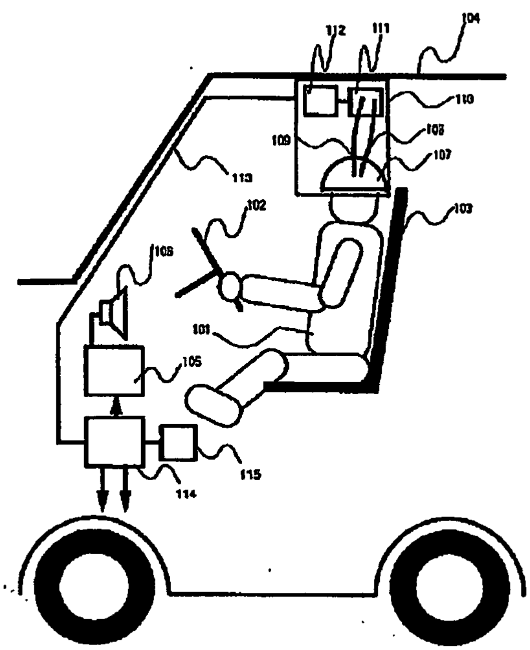
【図7】


計測領域１の
ヘモグロビン濃度演算
step1-1
特徴パラメータ演算
step1-2
閾値範囲内
step1-3
yes
信号１出力
no
計測領域２の
ヘモグロビン濃度演算
step1-4
特徴パラメータ演算
step1-5
閾値範囲内
step1-6
yes
信号２出力
no
計測領域３の
ヘモグロビン濃度演算
step1-7
特徴パラメータ演算
step1-8
閾値範囲内
step1-9
yes
信号３出力
no

【図9】

特徴パラメータ j / 計測領域 i	1	2	………	m－1	m
1	$S_{1,1,k}$ $A_{1,1,k}$	$S_{1,2,k}$ $A_{1,2,k}$	………	$S_{1,m-1,k}$ $A_{1,m-1,k}$	$S_{1,m,k}$ $A_{1,m,k}$
2	$S_{2,1,k}$ $A_{2,1,k}$	$S_{2,2,k}$ $A_{2,2,k}$	………	$S_{2,m-1,k}$ $A_{2,m-1,k}$	$S_{2,m,k}$ $A_{2,m,k}$
⋮	⋮	⋮	⋱	⋮	⋮
n－1	$S_{n-1,1,k}$ $A_{n-1,1,k}$	$S_{n-1,2,k}$ $A_{n-1,2,k}$	………	$S_{n-1,m-1,k}$ $A_{n-1,m-1,k}$	$S_{n-1,m,k}$ $A_{n-1,m,k}$
n	$S_{n,1,k}$ $A_{n,1,k}$	$S_{n,2,k}$ $A_{n,2,k}$	………	$S_{n,m-1,k}$ $A_{n,m-1,k}$	$S_{n,m,k}$ $A_{n,m,k}$

【図10】



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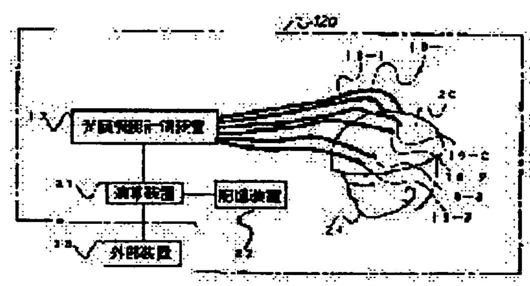
YAMASHITA YUICHI

(54) LIVING BODY INPUT DEVICE AND LIVING BODY CONTROLLER USING OPTICAL LIVING BODY MEASUREMENT METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To control a computer, a game, an environment controller, a learning level judgement device, the alarming device of a vehicle, diagnostic and alarming devices for medical use, a lie detector, an intention display device and an information transmitter, etc., by measuring localized brain functions and performing input to an external device.
SOLUTION: By an optical brain function measurement device 17, the head part transmission light intensity of a testee is measured by using optical fibers 18-1, 18-2 and 18-3 for irradiation and the optical fibers 19-1, 19-2 and 19-3 for convergence. When the head part transmission light intensity of respective measurement areas measured by the optical brain function measurement device 17 is inputted to an arithmetic unit 21, in the arithmetic unit 21, by using the head part transmission light intensity of the respective measurement areas, the absorption coefficient of oxidized and reduced haemoglobin and data for arithmetic operations stored in a storage device 22, optional output signals are decided and inputted to the external device 23. In the external device 23, an operation is performed corresponding to the kind of input signals.



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[Date of extinction of right]	

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] Since the passage light of this living body skin is condensed by irradiating said living body skin from at least one Mitsuteru gunner stage arranged on the living body skin, and this optical exposure means, At least one condensing means arranged on this living body skin, and a photodetection means for the Mitsuo object measurement to measure the living body passage light reinforcement condensed by this condensing means, The living body input unit using the Mitsuo object mensuration characterized by providing an operation means to determine the class of output signal from the data memorized by a storage means to memorize the reference data for determining the class of output signal, and the measurement signal measured by said photodetection means and this storage means.
[Claim 2] Since the passage light of this living body skin is condensed by irradiating said living body skin from at least one Mitsuteru gunner stage arranged on the living body skin, and this optical exposure means, At least one condensing means arranged on this living body skin, and a photodetection means for the Mitsuo object measurement to measure the living body passage light reinforcement condensed by this condensing means, A storage means to memorize the reference data for determining the class of output signal, The living body input unit equipped with an operation means to determine the class of output signal from the data memorized by the measurement signal measured by said photodetection means, and this storage means, And biological control equipment using the Mitsuo object mensuration which inputs the output signal determined with this living body input unit, and is characterized by providing the external device which operates an arbitration function according to the class of inputted signal.
[Claim 3] Since the passage light of this living body skin is condensed by irradiating said living body skin from at least one Mitsuteru gunner stage arranged on the living body skin, and this optical exposure means, At least one condensing means arranged on this living body skin, and a photodetection means for the Mitsuo object measurement to measure the living body passage light reinforcement condensed by this condensing means, A storage means to set up beforehand the reinforcement in the hemoglobin concentration rate of change of the arbitration time interval which should be calculated, and the arbitration frequency of time amount change of hemoglobin concentration etc. as reference data of a feature parameter, and to memorize this, From the living body passage light reinforcement measured by said photodetection means, the oxyhemoglobin concentration change value within a brain of the arbitration location within a brain, a reduction hemoglobin concentration change value, or the total hemoglobin concentration change value is calculated. The living body input unit equipped with an operation means to determine the class of output signal from the data which calculated the value of the feature parameter of arbitration from this change value, and were memorized by the value and said storage means of a feature parameter of this arbitration, And biological control equipment using the Mitsuo object mensuration which inputs the output signal determined with this living body input unit, and is characterized by providing the external device which operates an arbitration function according to the class of inputted signal.
[Claim 4] In the biological control equipment using the Mitsuo object mensuration according to claim 2 or 3 said operation means Each description parameter value about the measurement

signal measured for every measurement location, the oxyhemoglobin concentration change value within a brain, a reduction hemoglobin concentration change value, or the total hemoglobin concentration change value is calculated. Biological control equipment using the Mitsuo object mensuration characterized by performing the operation which determines the class of output signal from the comparison result for said every description parameter value as compared with the arbitration threshold which is memorized by said each calculated description parameter value and storage means, and which is set up by receiving for every feature parameter.
[Claim 5] In the biological control equipment using the Mitsuo object mensuration according to claim 2 or 3 said operation means Each description parameter value about the measurement signal measured for every measurement location, the oxyhemoglobin concentration change value within a brain, a reduction hemoglobin concentration change value, or the total hemoglobin concentration change value is calculated. From the study data which consist of an average value which was matched for every class of each output signal memorized by said each calculated description parameter value and storage means, and which receives for every feature parameter, and a standard-deviation value Calculate the Mahalanobis distance for every class of each output signal, and it searches for the Mahalanobis distance which serves as min from the Mahalanobis distance for every class of each of said calculated output signal. And biological control equipment using the Mitsuo object mensuration characterized by performing the operation which determines said minimum Mahalanobis distance for which it searched, and the class of corresponding output signal as the class of output signal when said minimum Mahalanobis distance for which it searched serves as smallness from the threshold set up beforehand.
[Claim 6] In the biological control equipment using the Mitsuo object mensuration according to claim 2 or 3 said operation means Each description parameter value about the measurement signal measured for every measurement location, the oxyhemoglobin concentration change value within a brain, a reduction hemoglobin concentration change value, or the total hemoglobin concentration change value is calculated. It inputs into the neural network who learned said each calculated description parameter value for every measurement location so that the class of output signal of arbitration might be determined corresponding to said each calculated description parameter value for every measurement location. Biological control equipment using the Mitsuo object mensuration characterized by performing the operation which determines the class of output signal.
[Claim 7] In the biological control equipment using the Mitsuo object mensuration according to claim 2 or 3 said feature parameter The oxyhemoglobin concentration change value within a brain in arbitration measurement time amount, a reduction hemoglobin concentration change value, or the addition value of the total hemoglobin concentration change value Or the average of the oxyhemoglobin concentration change value within a brain in arbitration measurement time amount, a reduction hemoglobin concentration change value, or the total hemoglobin concentration change value Or the arbitration frequency component of the oxyhemoglobin concentration change value within a brain in arbitration measurement time amount, a reduction hemoglobin concentration change value, or the total hemoglobin concentration change value Or biological control equipment using the Mitsuo object mensuration characterized by being the oxyhemoglobin concentration change value within a brain, the reduction hemoglobin concentration change value, or the total rate of a hemoglobin concentration change value change in arbitration measurement time amount.
[Claim 8] In the biological control equipment using the Mitsuo object mensuration according to claim 2 to 7 The Mitsuteru gunner stage and a condensing means are arranged on the skin of the operator who is an analyte person, using a microcomputer as said external device. When a signal is inputted into the above-mentioned microcomputer from a living body input unit when a living body input unit detects an analyte person's nap condition and the above-mentioned analyte person's nap condition is detected, and, as for this microcomputer, the above-mentioned signal is inputted, Biological control equipment using the Mitsuo object mensuration characterized by outputting an alarm or making a brake drive.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention by inputting into an external device the output signal from the living body input unit which used the Mitsuo object mensuration Control equipment about the control device which performs various control, without using a keyboard, a mouse, and a handle in detail, or It is related with the living body input unit and biological control equipment using the Mitsuo object mensuration which controls a nap alarm, controls environmental equipment, judges whenever [study], displays the feeling and thinking of a small child, a sick person, an animal, etc., or discovers a lie.
[0002]
[Description of the Prior Art] Conventionally, equipments, such as a computer and a game, are controlled from the input unit with various keyboards, mice, handles, etc., in order to operate. However, the input unit which such human being operates on hand and foot is difficult for reducing the presence in a game or a physically handicapped person etc. operating it. Then, the equipment which performs the direct input from a brain using an electroencephalogram is proposed by JP,7-124331,A. It is going to control the computer, especially the game machine by this equipment by inputting an electroencephalogram into a computer as it is like [when measuring an electrocardiogram]. Control of the external device of the patient by whom a failure is accepted in a motor function is possible for the direct input device from such a brain, and the contribution to a physically handicapped person's social participation is also expected.
[0003]
[Problem(s) to be Solved by the Invention] By the way, field division is carried out by different cytoarchitecture, and each field shares a different function further so that human being's brain may be expressed with Broadmann's atlas of brain. For example, if a brain is seen from width, the field where the field where the field which participates in spontaneous movements (a hand, a finger, guide peg, etc.) participates in the summit section, feeling, vision, etc. participates in the regio occipitalis capitis and language will be the predetermined section of a left half, and will be shared, respectively. Thus, in order to extract the information from the pinpointed location with high degree of accuracy, it is necessary to use a metering device with high spatial resolving power. However, since a dielectric constant is uneven in a living body and the source location of a signal becomes indefinite, the electroencephalogram used in the conventional technique has low spatial resolving power. Moreover, in order that the myoelectric potential by analyte moving might be greatly reflected in a signal and might have a bad influence on electroencephalogram detection by this, there is also a constraint that analyte must be restrained, at the time of measurement, and practicality was very missing. Therefore, the approach using an electroencephalogram as an input signal from a brain has a problem in precision and practicality directly. The purpose of this invention is by solving such a conventional technical problem and using a somatometry signal with high spatial resolving power as an input signal to offer the living body input unit and biological control equipment using the high somatometry approach of precision and practicality.
[0004]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the living body input unit using the Mitsuo object mensuration by this invention Since the passage light of this living body skin is condensed by irradiating said living body skin from at least one Mitsuteru gunner stage arranged on the living body skin, and this optical exposure means, At least one condensing means arranged on this living body skin, and a photodetection means for somatometry to measure the living body passage light reinforcement condensed by this condensing means, A storage means to set up beforehand the reinforcement in the hemoglobin concentration rate of change of the arbitration time interval which should be calculated, and the arbitration frequency of time amount change of hemoglobin concentration etc. as reference data of a feature parameter, and to memorize this, From the measurement signal measured by said photodetection means, or living body passage light reinforcement The oxyhemoglobin concentration change value within a brain of the arbitration location within a brain, a reduction hemoglobin concentration change value, or the total hemoglobin concentration change value is calculated. The value of the feature parameter of arbitration is calculated from this change value, and it is characterized by providing an operation means to determine the class of output signal from the data memorized by the value and said storage means of a feature parameter of this arbitration. Moreover, the biological control equipment using the Mitsuo object mensuration by this invention inputs the output signal determined with the above-mentioned living body input unit, and is characterized by providing the external device which operates an arbitration function according to the class of inputted signal. Here, although the light condensed by arrangement of the Mitsuteru gunner stage and a condensing means is classified into the reflected light and the transmitted light, it considers all as passage light including both in this invention.
[0005]
[Embodiment of the Invention] In this invention, the cerebral function activities localized using light are measured, and the measured signal is used as an input signal to a computer or an external device. That is, the signal measured, respectively is inputted into an arithmetic unit by setting one or more optical fibers for an exposure, and one or more optical fibers for condensing as one or more measurement fields (for example, the right-hand finger motor area, the left-hand finger motor area, the speech center, etc.) of a head, and condensing the head passage light of the subject. In an arithmetic unit, the class of output signal, such as clicking [in cursor] cursor from the measurement signal itself to migration and the input of the speech center to the input of migration and left-hand finger movement to the input of right-hand finger movement for example, on right-hand side to left-hand side, is determined, and an output signal is inputted into external devices, such as a computer, a word processor, or a game machine. An external device performs actuation according to the class of input signal. By other approaches of an arithmetic unit, by calculating the oxyhemoglobin concentration change value within a brain, a reduction hemoglobin concentration change value, or the total hemoglobin concentration change value from the measured passage light reinforcement, calculating the description parameter value from these values, and comparing the description parameter value memorized by storage with the calculated description parameter value, the class of output signal is determined and an output signal is inputted into an external device. Furthermore, the ** which does not make the input signal of an external device correspond to each measurement field as other measurement approaches, The subject is made to imagine "it clicks" etc. "cursor — the right — " — "cursor — the left — " — The standard-deviation value and average value for every feature parameter for every measurement field are memorized as study data to the store, and actual measurement values are compared with those study data, and if it is in tolerance and is in agreement, it will consider as an output signal. [at that time] In order to determine the class of output signal by this approach using a feature parameter, the Mahalanobis distance can be used, and also a neural network can also be used. Here, the Mahalanobis distance is an index which judges whether an actual measurement value belongs to the distribution, when a measurement value etc. is expressed by the normal distribution which has distribution. Since a computer, a word processor, or a game machine can be controlled by this, without using a keyboard, a mouse, etc., it can use also as an object for trouble back tone. Furthermore, it is [whenever / nap alarm / of an operator / environment control unit, and study] applicable to declaration-of-intention

equipments, such as judgment equipment, a sick person, a small child, and an animal, a data transmission unit, or the lie detector by arranging many the exposure light means and the condensing means of a point to analyte.
[0006]
[Example] Hereafter, a drawing explains the principle of operation and the example of this invention to a detail. Drawing 1 is the outline block diagram of the equipment (it abbreviates to an optical cerebral function metering device henceforth) which measures the cerebral function activities localized using light. In this invention, the localized cerebral function activities are measured using light, and the measured signal is made into the input signal to a computer. Here, oxyhemoglobin concentration change and reduction hemoglobin concentration change are measured independently, respectively by using two waves for exposure wavelength for the purpose of the oxidization in a living body, and reduction hemoglobin concentration change measurement. That is, oxyhemoglobin concentration and reduction HEMOKUROBIN concentration are measured by the difference in a color by the absorption of light. If wavelength is increased further, while precision will improve, measurement of matter concentration other than oxidization and the reduced hemoglobin is possible. Although the case where an optical exposure location and one photodetection location are set up is explained here, it is easy to increase a number, respectively. The light of specific wavelength is emitted from the light source 1-1 and 1-2, and incidence is carried out to an optical fiber 2-1 and 2-2, respectively. Here, the wavelength from the light source 1-1 is lambda 1, is the wavelength lambda 2 from the light source 1-2, and is chosen from the range of 400 to 2400nm. When measuring the hemodynamics in a living body especially, it is desirable to choose from the range of 700 to 1100nm so that a wavelength difference may be set to less than 50nm in order to raise precision. That is, in this wavelength range, the permeability of light is high. Since the crystal of water also becomes large on the wavelength beyond this and absorption of the hemoglobin blood itself also becomes large less than [this], it is inconvenient. Moreover, intensity modulation of the light source 1-1 and 1-2 is carried out on the frequencies f1 and f2 which change with the drive circuit 4-1 and 4-2, respectively. Each drive circuit 4-1 and the signalling frequency from 4-2 are inputted into a phase detector 9-1 and 9-2 as reference signalling frequency, respectively. This is for taking out oxidization and a reduction hemoglobin concentration value from the wavelength with which oxidization and a reduction hemoglobin concentration change value were mixed separately.
[0007] An optical fiber 2-1 and 2-2 have connected with an optical directional coupler 3, it is mixed and incidence of the light source 1-1 and the light from 1-2 is carried out to the optical fiber 5 for an exposure. the scalp of the optical fiber 5 for an exposure to the subject 6 — from a top, light is irradiated and living body passage light is condensed with the optical fiber 7 for condensing. This measures the difference in the color by ** of the oxidization which flows the inside of blood, and reduction hemoglobin concentration. In the artery, although the saturation of oxygen (rate that the oxyhemoglobin in [all] hemoglobin occupies) is high, in the vein, the saturation of oxygen is falling as compared with an artery. Here, although distance between the optical fiber 5 for an exposure and the optical fiber 7 for condensing is made into the distance of 10-50mm with a measurement location, it is set to 30mm by this equipment configuration. living body passage light [in / incidence of the living body passage light condensed with the optical fiber 7 for condensing is carried out to a photodetector 8, respectively and / each condensing location] — photo electric conversion — and it is amplified. A photo-multiplier and an avalanche photodiode are used for a photodetector 8. After the output signal from a photodetector 8 is distributed two times, it is inputted into a phase detector 9-1 and 9-2. Although two waves of irradiated living body passage light is being mixed to the Gentlemen phase wave detector 9-1 and the signal inputted into 9-2 Since reference freqency is inputted into the Gentlemen phase wave detector 9-1 and 9-2 from the drive circuit 4-1 and 4-2, respectively, in a phase detector 9-1, living body passage light reinforcement from the light source 1-1 can be carried out, and separation detection of the living body passage light reinforcement from the light source 1-2 can be carried out in a phase detector 9-2.
[0008] After inputting respectively into an analog-digital converter (it abbreviates to an A/D converter henceforth) 10-1, and 10-2 the living body passage light signal on the strength

detected by phase discriminator 9-1 and 9-2 and changing it into a digital signal, it incorporates to an arithmetic unit 11. In an arithmetic unit 11, from the time series signal of two waves of incorporated passage light reinforcement, the sum showing oxyhemoglobin concentration, reduction hemoglobin concentration, and blood volume of oxyhemoglobin concentration and reduction hemoglobin concentration is calculated, and it displays on a display 12 as a time series graph. The amount (volume) of the hemoglobin in blood is fixed, and if an oxyhemoglobin and the reduced hemoglobin are only added, the whole blood volume understands it. The method of calculating the oxyhemoglobin, the reduced hemoglobin, and the total hemoglobin concentration change accompanying cerebral function activities by this equipment configuration is proposed by for example, these people with the Japanese-Patent-Application-No. No. 30972 [seven to] specification, and the drawing (the data-processing approach). In addition, although only the amount from which hemoglobin concentration changed is calculated, if the operation except dispersion in a living body is performed, the absolute magnitude of concentration is also measurable here.

[0009] Drawing 2 is drawing showing the hemoglobin concentration change at the time of right-hand finger movement by the optical cerebral function metering device. Here, the field within the brain which participates in a motion of a right-hand finger (it abbreviates to the right-hand finger motor area henceforth) is made into a measurement field using this equipment, and time amount change of the oxyhemoglobin 14-1 at the time of performing right-hand finger movement, the reduced hemoglobin 14-2, and the total hemoglobin concentration change 14-3 is shown. In addition, 13 is a right-hand finger movement period. Drawing 3 is drawing showing the hemoglobin concentration change at the time of left-hand finger movement by the optical cerebral function metering device. Here, using this equipment, the left-hand finger motor area is made into a measurement field, and time amount change of the oxyhemoglobin 16-1 at the time of performing left-hand finger movement, the reduced hemoglobin 16-2, and the total hemoglobin concentration change 16-3 is shown. In addition, 15 is a left-hand finger movement period. If drawing 2 and drawing 3 are compared, the oxyhemoglobin concentration change 14-1 by the right-hand finger motor area and the total hemoglobin concentration change 14-3 during the right-hand finger movement period 13 show about 3 times as much variation as the oxyhemoglobin concentration change 16-1 by the left-hand finger motor area in the left-hand finger movement period 15, and the total hemoglobin concentration change 16-3 so that clearly. In addition, the motor area in cerebral left-hand side is an operating range related to a right half the body, and the field within a brain and the body part which involves have cross relation mutually. Moreover, the reduced hemoglobin does not carry out fluctuation so notably.

[0010] Drawing 4 is drawing showing the contour-line graph of the total hemoglobin concentration change at the time of right-hand finger movement by the optical cerebral function metering device. Here, using this equipment, it measures by the multipoint so that the right-hand finger motor area may be included, and the contour-line graph of the total hemoglobin concentration change at the time of performing right-hand finger movement is shown. By drawing 4 , left-hand side shows a before [a brain] side, and right-hand side shows [the vertical direction of drawing 4] the backside [the brain] for the cerebral upper and lower sides. Drawing 4 shows that the local part which shows such a remarkable change is measured by the optical cerebral function metering device. Drawing 5 is drawing showing the contour-line graph of the total hemoglobin concentration change at the time of the language remembrance by optical cerebral function equipment. Here, it measures by the multipoint so that the field (it abbreviates to the speech center henceforth) which participates in language activities may be included, and the contour-line graph of the oxyhemoglobin concentration change at the time of recollecting language is shown. The speech center exists in the location near the tempora within a left-hand side head brain. Also in this case, the local part which shows a remarkable change is measured by the optical cerebral function metering device. An optical cerebral function metering device can also measure the cerebral function activities by remembrance in this way. Therefore, in this invention, precision and practicality can realize the direct-input approach from a high brain by using the signal measured with the optical cerebral function metering device as an input signal to an external device.

[0011] Since the outline of the principle of invention was described above, below, the example of this invention is described. Drawing 6 is the block diagram of the optical cerebral function metering device in which one example of this invention is shown. In drawing 6 , 120 is a living body input unit, 23 is an external device and biological control equipment consists of these living body input unit 120 and an external device 23. The head transmitted light reinforcement of the subject 6 is measured using the optical cerebral function metering device 17, the optical fiber 18-1 for an exposure, 18-2 and 18-3, the optical fiber 19-1 for condensing, 19-2, and 19-3. the optical fiber 18-1 for an exposure, and the optical fiber 19-1 for condensing — the optical fiber 18-3 for an exposure and the optical fiber 19-3 for condensing are being fixed to the measurement field 1 for the optical fiber 18-2 for an exposure, and the optical fiber 19-2 for condensing by the measurement field 2 with the optical-fiber fixed helmet 20 to the measurement field 3, respectively. It is easy to increase the number of measurement fields here, and in each measurement field, in order to improve spatial resolving power, it is also easy to arrange two or more optical fibers. The head passage light reinforcement of each measurement field measured by the optical cerebral function metering device is inputted into an arithmetic unit 21. Using the absorbancy index of the oxidization memorized by the head passage light reinforcement and the store 22 of each of said measurement field, and the reduced hemoglobin, and the data for an operation, by the operation approach mentioned later, the signal of arbitration is specified and it inputs into an external device 23 in an arithmetic unit 21. In order to judge what kind of semantics the signal has in storage 22 beforehand, the result (the absorbancy index and data for an operation of HEMOKUROBIN) learned by then is memorized. In an external device 23, it operates according to the class of said inputted arbitration signal. As an external device 23, a computer, a word processor, a game machine, or a communication device can be used.

[0012] Next, the operation approach in the arithmetic unit 21 in drawing 6 is explained. Drawing 7 is a flow chart which shows the procedure of the arithmetic unit in drawing 6 . For example, the optical fiber 18-1 for an exposure and the optical fiber 19-1 for condensing are set as the left-hand finger motor area (measurement field 1), the optical fiber 18-2 for an exposure and the optical fiber 19-2 for condensing are set as the right-hand finger motor area (measurement field 2), the optical fiber 18-3 for an exposure and the optical fiber 19-3 for condensing are set as the speech center (measurement field 3), and the living body passage light reinforcement in each measurement field is inputted into an arithmetic unit 20.

(step 1-1) From the passage light reinforcement of each wavelength from the measurement field 1-1, oxidization, reduction, or the total hemoglobin concentration is calculated.

(step 1-2) Each **** calculated by step 1-1 calculates a feature parameter from the hemoglobin concentration of arbitration, i.e., oxidization, reduction and the total hemoglobin concentration, or one concentration in them. As a feature parameter, as for the addition value of the hemoglobin concentration of arbitration, and each **** of arbitration time amount, the reinforcement of the arbitration frequency of time amount change of the hemoglobin concentration of arbitration is used for each **** of an arbitration time interval, as for the rate of change and each **** of hemoglobin concentration of arbitration, and this can be determined variously, for example.

(step 1-3) measuring with the study value in storage 22 the description PARA meter calculated by step 1-2 — the description parameter value — oh, it judges whether it is in the threshold range of the arbitration which has carried out an Ecklonia setup, and a signal 1 will be outputted if it is within the limits. Moreover, if out of range, it will progress to step 1-4.

[0013] (step 1-4) From the passage light reinforcement of each wavelength from the measurement field 2, oxidization, reduction, or the total hemoglobin concentration is calculated.

(step 1-5) From the hemoglobin concentration of arbitration, each **** calculated by step 1-4 calculates a feature parameter. As a feature parameter, reinforcement [in / **** / the addition value of the hemoglobin concentration of arbitration and / of arbitration time amount / each / **** / of an arbitration time interval / each / in the rate of change and each **** of hemoglobin concentration of arbitration / the arbitration frequency of time amount change of the hemoglobin concentration of arbitration] is used, for example, and this can be determined variously.

(step 1-6) It judges whether it is in the threshold range of the arbitration set up beforehand, and if the description PARA meter calculated by step 1-5 is within the limits, it will output a signal 2. Moreover, if out of range, it will progress to step 1-7.
(step 1-7) From the passage light reinforcement of each wavelength from the measurement field 3, oxidization, reduction, or the total hemoglobin concentration is calculated.
(step 1-8) From the hemoglobin concentration of arbitration, each **** calculated by step 1-7 calculates a feature parameter. As a feature parameter, reinforcement [in / **** / of the addition value of the hemoglobin concentration of arbitration or an average value, or arbitration time amount / each / **** / of an arbitration time interval / each / in the rate of change and each **** of hemoglobin concentration of arbitration / the arbitration frequency of time amount change of the hemoglobin concentration of arbitration] is used, for example, and this can be determined variously.
(step 1-9) It judges whether it is in the threshold range of the arbitration set up beforehand, and if the description PARA meter calculated by step 1-8 is within the limits, it will output a signal 1. Moreover, if out of range, it will return to step 1-1.
[0014] Here, the external device 23 is always changed into the waiting state waiting for an input supposing an external device 23 being a computer. Furthermore, it is possible to also make the function of an external device [beforehand as opposed to / cursor / to the input of the left and a signal 2 / to the input of the right and a signal 3 / like a click / a signal in cursor] correspond beforehand to the input of a signal 1. Moreover, as an escape of this operation approach, if it is made to output [in in a threshold range] 1 in step 1-3, step 1-6, and step 1-9 in besides 0 and a threshold range, eight kinds of combination can be made as a signal outputted from an arithmetic unit 21 (000-111). In this case, what is necessary is to perform the output from a signal 1 to a signal 8, and just to opt for arbitration functional actuation of the external device 23 corresponding to each signal beforehand. Thus, by the 1st example of an operation, the right-hand finger motor area, the left-hand finger motor area, and the speech center were defined beforehand, it is the case where a signal is measured for every location of the, and the case where a signal and functional actuation were made to correspond to 1 to 1 was stated.
[0015] Drawing 8 is a flow chart which shows the 2nd example of an operation procedure of the arithmetic unit in drawing 6 . In the 2nd example of the operation approach, it is the case where the signal inputted into an external device 23 as the oxidization, the reduction, or the total hemoglobin concentration change measured in each measurement field is not made to correspond to 1 to 1. For example, it is the approach of having aimed for every location in the case of the 1st example of the operation approach, having taken out the signal to it, and having made the specific signal corresponding to functional actuation. However, when it has the volition a user wants to move cursor to the left, it will have to recollect moving a left hand and will become the function of an actual external device, and the thing from which remembrance of a user was widely different. On the other hand, in the 2nd example of this operation approach, it is an approach in consideration of said trouble. First, i measurement fields are set up, the optical fiber for an exposure and the optical fiber for condensing are arranged to each measurement field, and the living body passage light reinforcement in each measurement field is inputted into an arithmetic unit 21. That is, in the 2nd example, it aims for every location, and a specific signal is not measured, but an optical fiber is connected to a head, without pinpointing a location concretely, optical cerebral function measurement when recollecting the actuation inputted into a computer is performed, this is performed several times, and is learned, and the result is beforehand memorized to storage 22. And it searches for whether concentration is calculated from the actually measured signal, a feature parameter is calculated, and the feature parameter same in the data of a store 22 exists this. Hereafter, it explains in accordance with the flow of drawing 8 .
[0016] (step 2-1) From the passage light reinforcement of each wavelength from each measurement field i of every, oxidization, reduction, or the total hemoglobin concentration is calculated.
(step 2-2) From the hemoglobin concentration of arbitration, each **** calculated by step 2-1 calculates the values Pi and j (matrix value) of each feature-parameter j of each measurement

field i of every. As a feature parameter, reinforcement [in / **** / the addition value of the hemoglobin concentration of arbitration and / of arbitration time amount / each / **** / of an arbitration time interval / each / in the rate of change and each **** of hemoglobin concentration of arbitration / the arbitration frequency of time amount change of the hemoglobin concentration of arbitration] is used here, for example, and this can be determined variously.
(step 2-3) Here, the class of signal outputted from an arithmetic unit 21 is made into k kinds. The study data of general to a store 22 or a user individual are memorized beforehand. Study DS is the standard deviation value and the average of each feature-parameter j of every of each measurement field i of every which have the same structure in each output signal k of every. Namely, it is premised on probability distribution of a feature parameter being GAUSHIAN distribution. A standard deviation value and the average can describe a gauss function. For example, when an external device 23 is assumed to be a computer and the signal k from an arithmetic unit 21 is beforehand inputted into said computer, it sets up so that cursor may move to the right. Moreover, a user carries the optical cerebral function metering device 17 beforehand, and it performs recollecting with "cursor is moved to the right" two or more times. At this time, a standard deviation value and the average are calculated to each feature-parameter j of every [of each measurement field i of every / which is measured]. The standard-deviation value and average value of each feature-parameter j of every of each measurement field i of every which were acquired here are memorized to storage 22 as study data of Signal k. In this step 2-3, said study data Di, j, and k memorized are read. Drawing 9 is drawing showing the DS of these study data Di, j, and k. In drawing 9 , S expresses a standard deviation value, A expresses the average, and a dotted line means an abbreviation. Moreover, the measurement field i is made into n places, and the number of classes of feature-parameter j is made into m kinds.
[0017] (step 2-4) The Mahalanobis distance MDk is calculated to each signal k of every using the values Pi and j of all the study data Di, j, and k memorized and each feature-parameter j of each measurement field i of every [which was calculated step2-2]. The Mahalanobis distance is expressed with an easy well-known formula.
(step 2-5) It searches for the minimum Mahalanobis distance MDk from the Mahalanobis distance MDk of each signal k of every [which was calculated by step 2-4]. If the minimum value in 1-k signals is chosen, it will serve as the minimum Mahalanobis distance.
(step 2-6) It judges whether the minimum Mahalanobis distance MDk is in the threshold range of arbitration. In being in within the limits, it progresses to step 2-7. Moreover, in being out of range, it returns to step 2-1.
(step 2-7) Signal k is outputted.
[0018] Although the operation approach of the 2nd example applies the Mahalanobis presumption approach, in order to perform same presumption, it also has a method of applying a neural network as the 3rd operation approach. In this case, each feature-parameter j of each measurement field i of every is inputted into neural network input-side each terminal, and each signal k (k=1-l) is assigned to output side each terminal. Beforehand, the neural network learns by use of the multiple times of every user and a common user so that the signal k of arbitration may be outputted with the value of each feature-parameter j of each measurement field i of every. By using this neural network that learned, it can function as Mahalanobis presumption shown in drawing 8 similarly, and the signal corresponding to what the user recollected can be outputted. In drawing 6 , a neural network is connected to the latter part of an arithmetic unit 21, and a feature parameter is inputted into input-side each network terminal. An external device 23 is connected to output side each network terminal. In addition, of course, the arithmetic unit other than the operation approach of the 1st example, the 2nd example, and the 3rd example can also determine the class of output signal, using directly the signal measured by the detector for optical cerebral function measurement.
[0019] Drawing 10 is the block diagram of the biological control equipment in which other examples of this invention are shown. drawing 10 — setting — 101 — an operator and 102 — a handle and 103 — a seat and 104 — an automobile and 105 — a drive circuit and 106 — a loudspeaker and 107 — an optical-fiber fastener or an optical-fiber fixed helmet, and 108 — the

optical fiber for an optical exposure, and 109 — for the living body light measurement section and 112, as for a signal line and 114, the input signal judging section and 113 are [the optical fiber for optical condensing, and 110 / an input unit and 111 / a microcomputer and 115] storage. This example shows the case where biological control equipment is applied as a nap alarm at the time of automobile operation. That is, the input device 110 (the somatometry section 111, the input signal judging section 112, the optical fiber 108 for an optical exposure, the optical fiber 109 for optical condensing, an optical-fiber fastener, or optical-fiber fixed helmet 107) constitutes the living body input device, and the microcomputer 114 is used as an external device. The condition that an operator 101 sits on a seat 103, operates a handle 102, and is driving the automobile 104 is shown. The operator 101 is wearing the optical-fiber fastener or the optical-fiber fixed helmet 107. One or more sets of optical fibers 108 for an optical exposure and the optical fiber 109 for optical condensing are being fixed to the optical-fiber fastener or the optical-fiber fixed helmet 107. From the optical fiber 108 for an optical exposure, light is irradiated by an operator's 101 head and living body passage light is always condensed with the optical fiber 109 for optical condensing currently fixed by arbitration distance(for example, about 30mm)-separating. The light source of light irradiated from the optical fiber 108 for an optical exposure has similarly the photodetector which detects the light which is in the living body light measurement section 111 in the input-device 110 interior, and was condensed with the optical fiber 109 for optical condensing in the living body light measurement section 111.

[0020] If the phase detection of the living body passage light reinforcement which gave modulation frequency on the strength which is different about the optical reinforcement irradiated for every different optical exposure location and every different wavelength, was detected by the photodetector, and was changed into the electrical signal carries out and it measures as shown here in the example shown in drawing 6 , it is possible to remove the effect of the stray light and to measure the living body passage light reinforcement for every wavelength for every measurement location. Although the arbitration multi-statement of the measurement location defined by 1 set of optical fibers 108 for an optical exposure and the optical fiber 109 for optical condensing is carried out and it does not interfere every operator 101, when the high regio frontalis capitis of living body permeability and the characteristic part where hemodynamics changes with sleepiness notably again are known beforehand, it is set as said characteristic part. Based on the measurement signal showing the head hemodynamics measured in the living body light measurement section 111, the signal of sleepiness is extracted in the input signal judging section 112. It consists of arithmetic units which perform the storage with which the constant data which needs the input signal judging section 112 for hemodynamics operations, such as optical parameters, such as hemoglobin, and the study data about an operator 101 are memorized, the operation of hemodynamics, and the judgment of an input signal here. Moreover, as the 3rd example of an operation procedure showed, it is also possible to use a neural network for the judgment of an input signal. Here, when an operator's 101 sleepiness is detected in the input signal judging section 112, close is carried out to a microcomputer 114 using a signal line 113 from an input unit 110, and a signal is outputted to the nap alarm which consists of a drive circuit 105 and a loudspeaker 106 from a microcomputer 114. A nap alarm will function on a loudspeaker 106 as uttering the voice of warning, if a signal is inputted. Here, it is possible to stimulate by various approaches, such as stimulating an operator with voice and also vibrating a stimulus or a seat with light as a function of the nap alarm 105. Moreover, the voice data memorized by the store 115 according to the level of an alarm can be chosen from a microcomputer 114, and the speech information which has the semantics called "risk and risk ..." can also be outputted. Moreover, it is also possible to input a signal into a nap alarm by the electromagnetic wave, without carrying out the interior of the input device 110 to the optical-fiber fastener 107, and using a signal line 113. Furthermore, when a microcomputer 114 judges that the alarm level went up, by carrying out signal transduction to a downward arrow head from a microcomputer 114, brakes are applied or it is considering as the configuration which can also output the signal which suspends an engine.

[0021] as an alarm — not only the automobile of drawing 10 but all migration means, such as an

airplane and an electric car, — being applicable — under operation of these migration means — sleepiness, fatigue, and since — admiration — a redout, a blackout, etc. are applicable as equipment which judges the feeling which causes trouble to operation and gives an alarm to it. In addition, a redout and a blackout are symptoms which the blood flow within a brain concentrates on a part with big acceleration, and cause loss of visual disorder or consciousness during operation of an airplane etc. Thus, if a living body input unit is used as an input unit of a microcomputer, it is applicable also as an environment control unit, for example. That is, subjective feelings, such as a cold hot relaxed feeling, can be judged, and it can use as equipment which can control environments, such as environmental temperature, environmental music, brightness, and an image. Moreover, it is [whenever / study] applicable also as judgment equipment. That is, extent of study, such as learning and movement (rehabilitation is also included), is judged, and it can be used as equipment which displays the skill level. Based on the displayed skill level, it can also use as training equipment with which a test subject trains repeatedly. Moreover, it is applicable also as a medical-application diagnosis and an alarm. That is, it is applicable to the diagnostic equipment for epilepsy focal decision, the equipment of cerebral function inspection of an encephalopathy patient, the alarm of an epileptic stroke, etc. Moreover, although an intention cannot be transmitted outside from the patient of the myonosus or a vegetative state, a small child, an animal, etc. or an intention does not pass, it is applicable also as equipment which displays feeling and thinking. It catches that the small child considers being more concretely shown by him with a living body input device, and it is changed into a digital electrical signal, it inputs into a microcomputer, the language which has semantics in memory beforehand is registered, the selection judging of it is carried out, and it outputs with voice. Moreover, the information from an infantile brain is caught with a living body input unit, change of the brain of **** is detected, it is made into a phoneme, it can input into an electronic speech circuit and volition can be made to transmit by making into a voice what the small child considers. furthermore, what is wanted by attaching in animals, such as an animal and a pet, — it can know a thing. Moreover, feeling, such as joy, anger, humor and pathos, can be judged, and it can apply also to the equipment which transmits feeling information with a TV phone etc. From the feeling information transmitted by this equipment, the expression of the computer graphics of the face displayed on a **** side is generable. Moreover, concentration can be judged and it can apply also to the equipment which displays this. Furthermore, it is applicable also as lie detector.

[0022]

[Effect of the Invention] Since according to this invention the localized cerebral function is measured with an optical cerebral function metering device and a measurement signal is used as an input signal to an external device as explained above, an external device can be controlled, without using a keyboard, a mouse, and a handle, and also it is [whenever / alarm / of a vehicle /, environment control unit, and study] applicable to judgment equipment, a medical-application diagnosis and an alarm, declaration-of-intention equipment, a data transmission unit, concentration judging equipment, the lie detector, etc. Therefore, communication with information the non-transmitted object which was not made is attained conventionally.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention by inputting into an external device the output signal from the living body input unit which used the Mitsuo object mensuration Control equipment about the control device which performs various control, without using a keyboard, a mouse, and a handle in detail, or It is related with the living body input unit and biological control equipment using the Mitsuo object mensuration which controls a nap alarm, controls environmental equipment, judges whenever [study], displays the feeling and thinking of a small child, a sick person, an animal, etc., or discovers a lie.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Conventionally, equipments, such as a computer and a game, are controlled from the input unit with various keyboards, mice, handles, etc., in order to operate. However, the input unit which such human being operates on hand and foot is difficult for reducing the presence in a game or a physically handicapped person etc. operating it. Then, the equipment which performs the direct input from a brain using an electroencephalogram is proposed by JP,7-124331,A. It is going to control the computer, especially the game machine by this equipment by inputting an electroencephalogram into a computer as it is like [when measuring an electrocardiogram]. Control of the external device of the patient by whom a failure is accepted in a motor function is possible for the direct input device from such a brain, and the contribution to a physically handicapped person's social participation is also expected.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] Since according to this invention the localized cerebral function is measured with an optical cerebral function metering device and a measurement signal is used as an input signal to an external device as explained above, an external device can be controlled, without using a keyboard, a mouse, and a handle, and also it is [whenever / alarm / of a vehicle /, environment control unit, and study] applicable to judgment equipment, a medical-application diagnosis and an alarm, declaration-of-intention equipment, a data transmission unit, concentration judging equipment, the lie detector, etc. Therefore, communication with information the non-transmitted object which was not made is attained conventionally.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, field division is carried out by different cytoarchitecture, and each field shares a different function further so that human being's brain may be expressed with Broadmann's atlas of brain. For example, if a brain is seen from width, the field where the field where the field which participates in spontaneous movements (a hand, a finger, guide peg, etc.) participates in the summit section, feeling, vision, etc. participates in the regio occipitalis capitis and language will be the predetermined section of a left half, and will be shared, respectively. Thus, in order to extract the information from the pinpointed location with high degree of accuracy, it is necessary to use a metering device with high spatial resolving power. However, since a dielectric constant is uneven in a living body and the source location of a signal becomes indefinite, the electroencephalogram used in the conventional technique has low spatial resolving power. Moreover, in order that the myoelectric potential by analyte moving might be greatly reflected in a signal and might have a bad influence on electroencephalogram detection by this, there is also a constraint that analyte must be restrained, at the time of measurement, and practicality was very missing. Therefore, the approach using an electroencephalogram as an input signal from a brain has a problem in precision and practicality directly. The purpose of this invention is by solving such a conventional technical problem and using a somatometry signal with high spatial resolving power as an input signal to offer the living body input unit and biological control equipment using the high somatometry approach of precision and practicality.

[Translation done.]

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the living body input unit using the Mitsuo object mensuration by this invention Since the passage light of this living body skin is condensed by irradiating said living body skin from at least one Mitsuteru gunner stage arranged on the living body skin, and this optical exposure means, At least one condensing means arranged on this living body skin, and a photodetection means for somatometry to measure the living body passage light reinforcement condensed by this condensing means, A storage means to set up beforehand the reinforcement in the hemoglobin concentration rate of change of the arbitration time interval which should be calculated, and the arbitration frequency of time amount change of hemoglobin concentration etc. as reference data of a feature parameter, and to memorize this, From the measurement signal measured by said photodetection means, or living body passage light reinforcement The oxyhemoglobin concentration change value within a brain of the arbitration location within a brain, a reduction hemoglobin concentration change value, or the total hemoglobin concentration change value is calculated. The value of the feature parameter of arbitration is calculated from this change value, and it is characterized by providing an operation means to determine the class of output signal from the data memorized by the value and said storage means of a feature parameter of this arbitration. Moreover, the biological control equipment using the Mitsuo object mensuration by this invention inputs the output signal determined with the above-mentioned living body input unit, and is characterized by providing the external device which operates an arbitration function according to the class of inputted signal. Here, although the light condensed by arrangement of the Mitsuteru gunner stage and a condensing means is classified into the reflected light and the transmitted light, it considers all as passage light including both in this invention.
[0005]
[Embodiment of the Invention] In this invention, the cerebral function activities localized using light are measured, and the measured signal is used as an input signal to a computer or an external device. That is, the signal measured, respectively is inputted into an arithmetic unit by setting one or more optical fibers for an exposure, and one or more optical fibers for condensing as one or more measurement fields (for example, the right-hand finger motor area, the left-hand finger motor area, the speech center, etc.) of a head, and condensing the head passage light of the subject. In an arithmetic unit, the class of output signal, such as clicking [in cursor] cursor from the measurement signal itself to migration and the input of the speech center to the input of migration and left-hand finger movement to the input of right-hand finger movement for example, on right-hand side to left-hand side, is determined, and an output signal is inputted into external devices, such as a computer, a word processor, or a game machine. An external device performs actuation according to the class of input signal. By other approaches of an arithmetic unit, by calculating the oxyhemoglobin concentration change value within a brain, a reduction hemoglobin concentration change value, or the total hemoglobin concentration change value from the measured passage light reinforcement, calculating the description parameter value from these values, and comparing the description parameter value memorized by storage with the calculated description parameter value, the class of output signal is determined and an output signal is inputted into an external device. Furthermore, the ** which does not make the input

signal of an external device correspond to each measurement field as other measurement approaches, The subject is made to imagine "it clicks" etc. "cursor — the right — " — "cursor — the left — " — The standard-deviation value and average value for every feature parameter for every measurement field are memorized as study data to the store, and actual measurement values are compared with those study data, and if it is in tolerance and is in agreement, it will consider as an output signal. [at that time] In order to determine the class of output signal by this approach using a feature parameter, the Mahalanobis distance can be used, and also a neural network can also be used. Here, the Mahalanobis distance is an index which judges whether an actual measurement value belongs to the distribution, when a measurement value etc. is expressed by the normal distribution which has distribution. Since a computer, a word processor, or a game machine can be controlled by this, without using a keyboard, a mouse, etc., it can use also as an object for trouble back tone. Furthermore, it is [whenever / nap alarm / of an operator / environment control unit, and study] applicable to declaration-of-intention equipments, such as judgment equipment, a sick person, a small child, and an animal, a data transmission unit, or the lie detector by arranging many the exposure light means and the condensing means of a point to analyte.

[Translation done.]

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3.In the drawings, any words are not translated.

EXAMPLE

[Example] Hereafter, a drawing explains the principle of operation and the example of this invention to a detail. Drawing 1 is the outline block diagram of the equipment (it abbreviates to an optical cerebral function metering device henceforth) which measures the cerebral function activities localized using light. In this invention, the localized cerebral function activities are measured using light, and the measured signal is made into the input signal to a computer. Here, oxyhemoglobin concentration change and reduction hemoglobin concentration change are measured independently, respectively by using two waves for exposure wavelength for the purpose of the oxidization in a living body, and reduction hemoglobin concentration change measurement. That is, oxyhemoglobin concentration and reduction HEMOKUROBIN concentration are measured by the difference in a color by the absorption of light. If wavelength is increased further, while precision will improve, measurement of matter concentration other than oxidization and the reduced hemoglobin is possible. Although the case where an optical exposure location and one photodetection location are set up is explained here, it is easy to increase a number, respectively. The light of specific wavelength is emitted from the light source 1-1 and 1-2, and incidence is carried out to an optical fiber 2-1 and 2-2, respectively. Here, the wavelength from the light source 1-1 is lambda 1, is the wavelength lambda 2 from the light source 1-2, and is chosen from the range of 400 to 2400nm. When measuring the hemodynamics in a living body especially, it is desirable to choose from the range of 700 to 1100nm so that a wavelength difference may be set to less than 50nm in order to raise precision. That is, in this wavelength range, the permeability of light is high. Since the crystal of water also becomes large on the wavelength beyond this and absorption of the hemoglobin blood itself also becomes large less than [this], it is inconvenient. Moreover, intensity modulation of the light source 1-1 and 1-2 is carried out on the frequencies f1 and f2 which change with the drive circuit 4-1 and 4-2, respectively. Each drive circuit 4-1 and the signalling frequency from 4-2 are inputted into a phase detector 9-1 and 9-2 as reference signalling frequency, respectively. This is for taking out oxidization and a reduction hemoglobin concentration value from the wavelength with which oxidization and a reduction hemoglobin concentration change value were mixed separately.
[0007] An optical fiber 2-1 and 2-2 have connected with an optical directional coupler 3, it is mixed and incidence of the light source 1-1 and the light from 1-2 is carried out to the optical fiber 5 for an exposure. the scalp of the optical fiber 5 for an exposure to the subject 6 — from a top, light is irradiated and living body passage light is condensed with the optical fiber 7 for condensing. This measures the difference in the color by ** of the oxidization which flows the inside of blood, and reduction hemoglobin concentration. In the artery, although the saturation of oxygen (rate that the oxyhemoglobin in [all] hemoglobin occupies) is high, in the vein, the saturation of oxygen is falling as compared with an artery. Here, although distance between the optical fiber 5 for an exposure and the optical fiber 7 for condensing is made into the distance of 10-50mm with a measurement location, it is set to 30mm by this equipment configuration. living body passage light [in / incidence of the living body passage light condensed with the optical fiber 7 for condensing is carried out to a photodetector 8, respectively and / each condensing location] — photo electric conversion — and it is amplified. A photo-multiplier and an avalanche photodiode are used for a photodetector 8. After the output signal from a photodetector 8 is

distributed two times, it is inputted into a phase detector 9-1 and 9-2. Although two waves of irradiated living body passage light is being mixed to the Gentlemen phase wave detector 9-1 and the signal inputted into 9-2 Since reference freqency is inputted into the Gentlemen phase wave detector 9-1 and 9-2 from the drive circuit 4-1 and 4-2, respectively, in a phase detector 9-1, living body passage light reinforcement from the light source 1-1 can be carried out, and separation detection of the living body passage light reinforcement from the light source 1-2 can be carried out in a phase detector 9-2.

[0008] After inputting respectively into an analog-digital converter (it abbreviates to an A/D converter henceforth) 10-1, and 10-2 the living body passage light signal on the strength detected by phase discriminator 9-1 and 9-2 and changing it into a digital signal, it incorporates to an arithmetic unit 11. In an arithmetic unit 11, from the time series signal of two waves of incorporated passage light reinforcement, the sum showing oxyhemoglobin concentration, reduction hemoglobin concentration, and blood volume of oxyhemoglobin concentration and reduction hemoglobin concentration is calculated, and it displays on a display 12 as a time series graph. The amount (volume) of the hemoglobin in blood is fixed, and if an oxyhemoglobin and the reduced hemoglobin are only added, the whole blood volume understands it. The method of calculating the oxyhemoglobin, the reduced hemoglobin, and the total hemoglobin concentration change accompanying cerebral function activities by this equipment configuration is proposed by for example, these people with the Japanese-Patent-Application-No. No. 30972 [seven to] specification, and the drawing (the data-processing approach). In addition, although only the amount from which hemoglobin concentration changed is calculated, if the operation except dispersion in a living body is performed, the absolute magnitude of concentration is also measurable here.

[0009] Drawing 2 is drawing showing the hemoglobin concentration change at the time of right-hand finger movement by the optical cerebral function metering device. Here, the field within the brain which participates in a motion of a right-hand finger (it abbreviates to the right-hand finger motor area henceforth) is made into a measurement field using this equipment, and time amount change of the oxyhemoglobin 14-1 at the time of performing right-hand finger movement, the reduced hemoglobin 14-2, and the total hemoglobin concentration change 14-3 is shown. In addition, 13 is a right-hand finger movement period. Drawing 3 is drawing showing the hemoglobin concentration change at the time of left-hand finger movement by the optical cerebral function metering device. Here, using this equipment, the left-hand finger motor area is made into a measurement field, and time amount change of the oxyhemoglobin 16-1 at the time of performing left-hand finger movement, the reduced hemoglobin 16-2, and the total hemoglobin concentration change 16-3 is shown. In addition, 15 is a left-hand finger movement period. If drawing 2 and drawing 3 are compared, the oxyhemoglobin concentration change 14-1 by the right-hand finger motor area and the total hemoglobin concentration change 14-3 during the right-hand finger movement period 13 show about 3 times as much variation as the oxyhemoglobin concentration change 16-1 by the left-hand finger motor area in the left-hand finger movement period 15, and the total hemoglobin concentration change 16-3 so that clearly. In addition, the motor area in cerebral left-hand side is an operating range related to a right half the body, and the field within a brain and the body part which involves have cross relation mutually. Moreover, the reduced hemoglobin does not carry out fluctuation so notably.

[0010] Drawing 4 is drawing showing the contour-line graph of the total hemoglobin concentration change at the time of right-hand finger movement by the optical cerebral function metering device. Here, using this equipment, it measures by the multipoint so that the right-hand finger motor area may be included, and the contour-line graph of the total hemoglobin concentration change at the time of performing right-hand finger movement is shown. By drawing 4 , left-hand side shows a before [a brain] side, and right-hand side shows [the vertical direction of drawing 4] the backside [the brain] for the cerebral upper and lower sides. Drawing 4 shows that the local part which shows such a remarkable change is measured by the optical cerebral function metering device. Drawing 5 is drawing showing the contour-line graph of the total hemoglobin concentration change at the time of the language remembrance by optical cerebral function equipment. Here, it measures by the multipoint so that the field (it abbreviates

to the speech center henceforth) which participates in language activities may be included, and the contour-line graph of the oxyhemoglobin concentration change at the time of recollecting language is shown. The speech center exists in the location near the tempora within a left-hand side head brain. Also in this case, the local part which shows a remarkable change is measured by the optical cerebral function metering device. An optical cerebral function metering device can also measure the cerebral function activities by remembrance in this way. Therefore, in this invention, precision and practicality can realize the direct-input approach from a high brain by using the signal measured with the optical cerebral function metering device as an input signal to an external device.
[0011] Since the outline of the principle of invention was described above, below, the example of this invention is described. Drawing 6 is the block diagram of the optical cerebral function metering device in which one example of this invention is shown. In drawing 6 , 120 is a living body input unit, 23 is an external device and biological control equipment consists of these living body input unit 120 and an external device 23. The head transmitted light reinforcement of the subject 6 is measured using the optical cerebral function metering device 17, the optical fiber 18-1 for an exposure, 18-2 and 18-3, the optical fiber 19-1 for condensing, 19-2, and 19-3. the optical fiber 18-1 for an exposure, and the optical fiber 19-1 for condensing — the optical fiber 18-3 for an exposure and the optical fiber 19-3 for condensing are being fixed to the measurement field 1 for the optical fiber 18-2 for an exposure, and the optical fiber 19-2 for condensing by the measurement field 2 with the optical-fiber fixed helmet 20 to the measurement field 3, respectively. It is easy to increase the number of measurement fields here, and in each measurement field, in order to improve spatial resolving power, it is also easy to arrange two or more optical fibers. The head passage light reinforcement of each measurement field measured by the optical cerebral function metering device is inputted into an arithmetic unit 21. Using the absorbancy index of the oxidization memorized by the head passage light reinforcement and the store 22 of each of said measurement field, and the reduced hemoglobin, and the data for an operation, by the operation approach mentioned later, the signal of arbitration is specified and it inputs into an external device 23 in an arithmetic unit 21. In order to judge what kind of semantics the signal has in storage 22 beforehand, the result (the absorbancy index and data for an operation of HEMOKUROBIN) learned by then is memorized. In an external device 23, it operates according to the class of said inputted arbitration signal. As an external device 23, a computer, a word processor, a game machine, or a communication device can be used.
[0012] Next, the operation approach in the arithmetic unit 21 in drawing 6 is explained. Drawing 7 is a flow chart which shows the procedure of the arithmetic unit in drawing 6 . For example, the optical fiber 18-1 for an exposure and the optical fiber 19-1 for condensing are set as the left-hand finger motor area (measurement field 1), the optical fiber 18-2 for an exposure and the optical fiber 19-2 for condensing are set as the right-hand finger motor area (measurement field 2), the optical fiber 18-3 for an exposure and the optical fiber 19-3 for condensing are set as the speech center (measurement field 3), and the living body passage light reinforcement in each measurement field is inputted into an arithmetic unit 20.
(step 1-1) From the passage light reinforcement of each wavelength from the measurement field 1-1, oxidization, reduction, or the total hemoglobin concentration is calculated.
(step 1-2) Each **** calculated by step 1-1 calculates a feature parameter from the hemoglobin concentration of arbitration, i.e., oxidization, reduction and the total hemoglobin concentration, or one concentration in them. As a feature parameter, as for the addition value of the hemoglobin concentration of arbitration, and each **** of arbitration time amount, the reinforcement of the arbitration frequency of time amount change of the hemoglobin concentration of arbitration is used for each **** of an arbitration time interval, as for the rate of change and each **** of hemoglobin concentration of arbitration, and this can be determined variously, for example.
(step 1-3) measuring with the study value in storage 22 the description PARA meter calculated by step 1-2 — the description parameter value — oh, it judges whether it is in the threshold range of the arbitration which has carried out an Ecklonia setup, and a signal 1 will be outputted if it is within the limits. Moreover, if out of range, it will progress to step 1-4.

[0013] (step 1-4) From the passage light reinforcement of each wavelength from the measurement field 2, oxidization, reduction, or the total hemoglobin concentration is calculated.
(step 1-5) From the hemoglobin concentration of arbitration, each **** calculated by step 1-4 calculates a feature parameter. As a feature parameter, reinforcement [in / **** / the addition value of the hemoglobin concentration of arbitration and / of arbitration time amount / each / **** / of an arbitration time interval / each / in the rate of change and each **** of hemoglobin concentration of arbitration / the arbitration frequency of time amount change of the hemoglobin concentration of arbitration] is used, for example, and this can be determined variously.
(step 1-6) It judges whether it is in the threshold range of the arbitration set up beforehand, and if the description PARA meter calculated by step 1-5 is within the limits, it will output a signal 2. Moreover, if out of range, it will progress to step 1-7.
(step 1-7) From the passage light reinforcement of each wavelength from the measurement field 3, oxidization, reduction, or the total hemoglobin concentration is calculated.
(step 1-8) From the hemoglobin concentration of arbitration, each **** calculated by step 1-7 calculates a feature parameter. As a feature parameter, reinforcement [in / **** / of the addition value of the hemoglobin concentration of arbitration or an average value, or arbitration time amount / each / **** / of an arbitration time interval / each / in the rate of change and each **** of hemoglobin concentration of arbitration / the arbitration frequency of time amount change of the hemoglobin concentration of arbitration] is used, for example, and this can be determined variously.
(step 1-9) It judges whether it is in the threshold range of the arbitration set up beforehand, and if the description PARA meter calculated by step 1-8 is within the limits, it will output a signal 1. Moreover, if out of range, it will return to step 1-1.
[0014] Here, the external device 23 is always changed into the waiting state waiting for an input supposing an external device 23 being a computer. Furthermore, it is possible to also make the function of an external device [beforehand as opposed to / cursor / to the input of the left and a signal 2 / to the input of the right and a signal 3 / like a click / a signal in cursor] correspond beforehand to the input of a signal 1. Moreover, as an escape of this operation approach, if it is made to output [in in a threshold range] 1 in step 1-3, step 1-6, and step 1-9 in besides 0 and a threshold range, eight kinds of combination can be made as a signal outputted from an arithmetic unit 21 (000-111). In this case, what is necessary is to perform the output from a signal 1 to a signal 8, and just to opt for arbitration functional actuation of the external device 23 corresponding to each signal beforehand. Thus, by the 1st example of an operation, the right-hand finger motor area, the left-hand finger motor area, and the speech center were defined beforehand, it is the case where a signal is measured for every location of the, and the case where a signal and functional actuation were made to correspond to 1 to 1 was stated.
[0015] Drawing 8 is a flow chart which shows the 2nd example of an operation procedure of the arithmetic unit in drawing 6 . In the 2nd example of the operation approach, it is the case where the signal inputted into an external device 23 as the oxidization, the reduction, or the total hemoglobin concentration change measured in each measurement field is not made to correspond to 1 to 1. For example, it is the approach of having aimed for every location in the case of the 1st example of the operation approach, having taken out the signal to it, and having made the specific signal corresponding to functional actuation. However, when it has the volition a user wants to move cursor to the left, it will have to recollect moving a left hand and will become the function of an actual external device, and the thing from which remembrance of a user was widely different. On the other hand, in the 2nd example of this operation approach, it is an approach in consideration of said trouble. First, i measurement fields are set up, the optical fiber for an exposure and the optical fiber for condensing are arranged to each measurement field, and the living body passage light reinforcement in each measurement field is inputted into an arithmetic unit 21. That is, in the 2nd example, it aims for every location, and a specific signal is not measured, but an optical fiber is connected to a head, without pinpointing a location concretely, optical cerebral function measurement when recollecting the actuation inputted into a computer is performed, this is performed several times, and is learned, and the result is

beforehand memorized to storage 22. And it searches for whether concentration is calculated from the actually measured signal, a feature parameter is calculated, and the feature parameter same in the data of a store 22 exists this. Hereafter, it explains in accordance with the flow of drawing 8 .
[0016] (step 2-1) From the passage light reinforcement of each wavelength from each measurement field i of every, oxidization, reduction, or the total hemoglobin concentration is calculated.
(step 2-2) From the hemoglobin concentration of arbitration, each **** calculated by step 2-1 calculates the values Pi and j (matrix value) of each feature-parameter j of each measurement field i of every. As a feature parameter, reinforcement [in / **** / the addition value of the hemoglobin concentration of arbitration and / of arbitration time amount / each / **** / of an arbitration time interval / each / in the rate of change and each **** of hemoglobin concentration of arbitration / the arbitration frequency of time amount change of the hemoglobin concentration of arbitration] is used here, for example, and this can be determined variously.
(step 2-3) Here, the class of signal outputted from an arithmetic unit 21 is made into k kinds. The study data of general to a store 22 or a user individual are memorized beforehand. Study DS is the standard deviation value and the average of each feature-parameter j of every of each measurement field i of every which have the same structure in each output signal k of every. Namely, it is premised on probability distribution of a feature parameter being GAUSHIAN distribution. A standard deviation value and the average can describe a gauss function. For example, when an external device 23 is assumed to be a computer and the signal k from an arithmetic unit 21 is beforehand inputted into said computer, it sets up so that cursor may move to the right. Moreover, a user carries the optical cerebral function metering device 17 beforehand, and it performs recollecting with "cursor is moved to the right" two or more times. At this time, a standard deviation value and the average are calculated to each feature-parameter j of every [of each measurement field i of every / which is measured]. The standard-deviation value and average value of each feature-parameter j of every of each measurement field i of every which were acquired here are memorized to storage 22 as study data of Signal k. In this step 2-3, said study data Di, j, and k memorized are read. Drawing 9 is drawing showing the DS of these study data Di, j, and k. In drawing 9 , S expresses a standard deviation value, A expresses the average, and a dotted line means an abbreviation. Moreover, the measurement field i is made into n places, and the number of classes of feature-parameter j is made into m kinds.
[0017] (step 2-4) The Mahalanobis distance MDk is calculated to each signal k of every using the values Pi and j of all the study data Di, j, and k memorized and each feature-parameter j of each measurement field i of every [which was calculated step2-2]. The Mahalanobis distance is expressed with an easy well-known formula.
(step 2-5) It searches for the minimum Mahalanobis distance MDk from the Mahalanobis distance MDk of each signal k of every [which was calculated by step 2-4]. If the minimum value in 1-k signals is chosen, it will serve as the minimum Mahalanobis distance.
(step 2-6) It judges whether the minimum Mahalanobis distance MDk is in the threshold range of arbitration. In being in within the limits, it progresses to step 2-7. Moreover, in being out of range, it returns to step 2-1.
(step 2-7) Signal k is outputted.
[0018] Although the operation approach of the 2nd example applies the Mahalanobis presumption approach, in order to perform same presumption, it also has a method of applying a neural network as the 3rd operation approach. In this case, each feature-parameter j of each measurement field i of every is inputted into neural network input-side each terminal, and each signal k (k=1-l) is assigned to output side each terminal. Beforehand, the neural network learns by use of the multiple times of every user and a common user so that the signal k of arbitration may be outputted with the value of each feature-parameter j of each measurement field i of every. By using this neural network that learned, it can function as Mahalanobis presumption shown in drawing 8 similarly, and the signal corresponding to what the user recollected can be outputted. In drawing 6 , a neural network is connected to the latter part of an arithmetic unit 21,

and a feature parameter is inputted into input-side each network terminal. An external device 23 is connected to output side each network terminal. In addition, of course, the arithmetic unit other than the operation approach of the 1st example, the 2nd example, and the 3rd example can also determine the class of output signal, using directly the signal measured by the detector for optical cerebral function measurement.

[0019] Drawing 10 is the block diagram of the biological control equipment in which other examples of this invention are shown. drawing 10 -- setting -- 101 -- an operator and 102 -- a handle and 103 -- a seat and 104 -- an automobile and 105 -- a drive circuit and 106 -- a loudspeaker and 107 -- an optical-fiber fastener or an optical-fiber fixed helmet, and 108 -- the optical fiber for an optical exposure, and 109 -- for the living body light measurement section and 112, as for a signal line and 114, the input signal judging section and 113 are [the optical fiber for optical condensing, and 110 / an input unit and 111 / a microcomputer and 115] storage. This example shows the case where biological control equipment is applied as a nap alarm at the time of automobile operation. That is, the input device 110 (the somatometry section 111, the input signal judging section 112, the optical fiber 108 for an optical exposure, the optical fiber 109 for optical condensing, an optical-fiber fastener, or optical-fiber fixed helmet 107) constitutes the living body input device, and the microcomputer 114 is used as an external device. The condition that an operator 101 sits on a seat 103, operates a handle 102, and is driving the automobile 104 is shown. The operator 101 is wearing the optical-fiber fastener or the optical-fiber fixed helmet 107. One or more sets of optical fibers 108 for an optical exposure and the optical fiber 109 for optical condensing are being fixed to the optical-fiber fastener or the optical-fiber fixed helmet 107. From the optical fiber 108 for an optical exposure, light is irradiated by an operator's 101 head and living body passage light is always condensed with the optical fiber 109 for optical condensing currently fixed by arbitration distance(for example, about 30mm)-separating. The light source of light irradiated from the optical fiber 108 for an optical exposure has similarly the photodetector which detects the light which is in the living body light measurement section 111 in the input-device 110 interior, and was condensed with the optical fiber 109 for optical condensing in the living body light measurement section 111.

[0020] If the phase detection of the living body passage light reinforcement which gave modulation frequency on the strength which is different about the optical reinforcement irradiated for every different optical exposure location and every different wavelength, was detected by the photodetector, and was changed into the electrical signal carries out and it measures as shown here in the example shown in drawing 6 , it is possible to remove the effect of the stray light and to measure the living body passage light reinforcement for every wavelength for every measurement location. Although the arbitration multi-statement of the measurement location defined by 1 set of optical fibers 108 for an optical exposure and the optical fiber 109 for optical condensing is carried out and it does not interfere every operator 101, when the high regio frontalis capitis of living body permeability and the characteristic part where hemodynamics changes with sleepiness notably again are known beforehand, it is set as said characteristic part. Based on the measurement signal showing the head hemodynamics measured in the living body light measurement section 111, the signal of sleepiness is extracted in the input signal judging section 112. It consists of arithmetic units which perform the storage with which the constant data which needs the input signal judging section 112 for hemodynamics operations, such as optical parameters, such as hemoglobin, and the study data about an operator 101 are memorized, the operation of hemodynamics, and the judgment of an input signal here. Moreover, as the 3rd example of an operation procedure showed, it is also possible to use a neural network for the judgment of an input signal. Here, when an operator's 101 sleepiness is detected in the input signal judging section 112, close is carried out to a microcomputer 114 using a signal line 113 from an input unit 110, and a signal is outputted to the nap alarm which consists of a drive circuit 105 and a loudspeaker 106 from a microcomputer 114. A nap alarm will function on a loudspeaker 106 as uttering the voice of warning, if a signal is inputted. Here, it is possible to stimulate by various approaches, such as stimulating an operator with voice and also vibrating a stimulus or a seat with light as a function of the nap alarm 105. Moreover, the voice

data memorized by the store 115 according to the level of an alarm can be chosen from a microcomputer 114, and the speech information which has the semantics called "risk and risk ..." can also be outputted. Moreover, it is also possible to input a signal into a nap alarm by the electromagnetic wave, without carrying out the interior of the input device 110 to the optical-fiber fastener 107, and using a signal line 113. Furthermore, when a microcomputer 114 judges that the alarm level went up, by carrying out signal transduction to a downward arrow head from a microcomputer 114, brakes are applied or it is considering as the configuration which can also output the signal which suspends an engine.
[0021] as an alarm — not only the automobile of drawing 10 but all migration means, such as an airplane and an electric car, — being applicable — under operation of these migration means — sleepiness, fatigue, and since — admiration — a redout, a blackout, etc. are applicable as equipment which judges the feeling which causes trouble to operation and gives an alarm to it. In addition, a redout and a blackout are symptoms which the blood flow within a brain concentrates on a part with big acceleration, and cause loss of visual disorder or consciousness during operation of an airplane etc. Thus, if a living body input unit is used as an input unit of a microcomputer, it is applicable also as an environment control unit, for example. That is, subjective feelings, such as a cold hot relaxed feeling, can be judged, and it can use as equipment which can control environments, such as environmental temperature, environmental music, brightness, and an image. Moreover, it is [whenever / study] applicable also as judgment equipment. That is, extent of study, such as learning and movement (rehabilitation is also included), is judged, and it can be used as equipment which displays the skill level. Based on the displayed skill level, it can also use as training equipment with which a test subject trains repeatedly. Moreover, it is applicable also as a medical-application diagnosis and an alarm. That is, it is applicable to the diagnostic equipment for epilepsy focal decision, the equipment of cerebral function inspection of an encephalopathy patient, the alarm of an epileptic stroke, etc. Moreover, although an intention cannot be transmitted outside from the patient of the myonosus or a vegetative state, a small child, an animal, etc. or an intention does not pass, it is applicable also as equipment which displays feeling and thinking. It catches that the small child considers being more concretely shown by him with a living body input device, and it is changed into a digital electrical signal, it inputs into a microcomputer, the language which has semantics in memory beforehand is registered, the selection judging of it is carried out, and it outputs with voice. Moreover, the information from an infantile brain is caught with a living body input unit, change of the brain of **** is detected, it is made into a phoneme, it can input into an electronic speech circuit and volition can be made to transmit by making into a voice what the small child considers. furthermore, what is wanted by attaching in animals, such as an animal and a pet, — it can know a thing. Moreover, feeling, such as joy, anger, humor and pathos, can be judged, and it can apply also to the equipment which transmits feeling information with a TV phone etc. From the feeling information transmitted by this equipment, the expression of the computer graphics of the face displayed on a **** side is generable. Moreover, concentration can be judged and it can apply also to the equipment which displays this. Furthermore, it is applicable also as lie detector.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the optical cerebral function metering device in which one example of this invention is shown.
[Drawing 2] It is drawing showing the hemoglobin concentration change at the time of right-hand finger movement by optical cerebral function equipment.
[Drawing 3] It is drawing showing the hemoglobin concentration change at the time of left-hand finger movement by optical cerebral function equipment.
[Drawing 4] It is drawing showing the contour-line graph of the total hemoglobin concentration change at the time of right-hand finger movement by optical cerebral function equipment.
[Drawing 5] It is drawing showing the contour-line graph of the total hemoglobin concentration change at the time of the language remembrance by optical cerebral function equipment.
[Drawing 6] It is the concrete equipment configuration Fig. of this invention.
[Drawing 7] It is the flow chart which shows the operation procedure of the arithmetic unit in drawing 6 .
[Drawing 8] It is the flow chart which shows other operation procedures of the arithmetic unit in drawing 6 .
[Drawing 9] It is drawing of the study DS memorized to the store of drawing 6 .
[Drawing 10] It is a block diagram at the time of applying the living body input unit based on this invention to the nap alarm at the time of automobile operation which is an external device.
[Description of Notations]
1-1 and 1-2 : The light source, 2-1, 2-2 : An optical fiber, 3: An optical directional coupler, 4-1, 4-2 : A light source driving gear, 5: The optical fiber for an exposure, 6: The subject, 7: The optical fiber for condensing, 8: A photodetector, 9-1 : A phase detector, 9-2 : A phase detector, 10-1 : An analog-digital converter, 10-2 : An analog-digital converter, 11: An arithmetic unit, 12: A display, 13: A right-hand finger movement period, 14-1 : Oxyhemoglobin concentration change, 14-2 : Reduction hemoglobin concentration, 14-3 : The total hemoglobin concentration, 15: A left-hand finger movement period, 16-1 : Oxyhemoglobin concentration change, 16-2 : Reduction hemoglobin concentration, 16-3 : The total hemoglobin concentration, 17: An optical cerebral function metering device, 20: An optical-fiber fixed helmet, 18-1, 18-2, 18-3 : The optical fiber for an exposure, 21:arithmetic unit, 19-1, 19-2, the optical fiber for 19-3:condensing, 22:storage, 23:external device, 24:user, a 101:operator, a 102:handle, a 104:automobile, a 106:loudspeaker, 111 : The Mitsuo object measurement section, 112: The input-signal judging section, 114: Microcomputer (microcomputer)
113: A signal line, a 110,120:living body input device, a 103:seat, a 105:nap alarm, the optical fiber for a 108:light exposure, a 107:optical-fiber fastener or an optical-fiber fixed helmet, 109 : the optical fiber for optical condensing.

[Translation done.]

* NOTICES *

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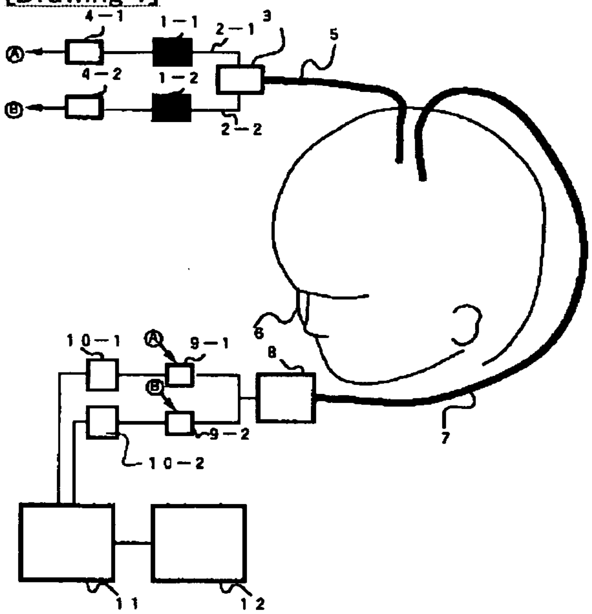
damages caused by the use of this translation.

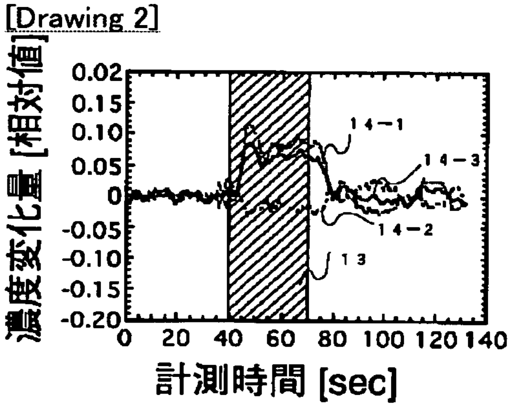
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

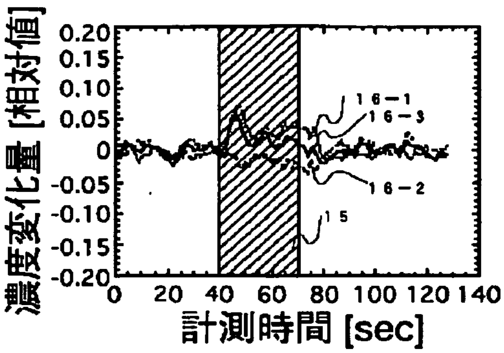
[Drawing 1]



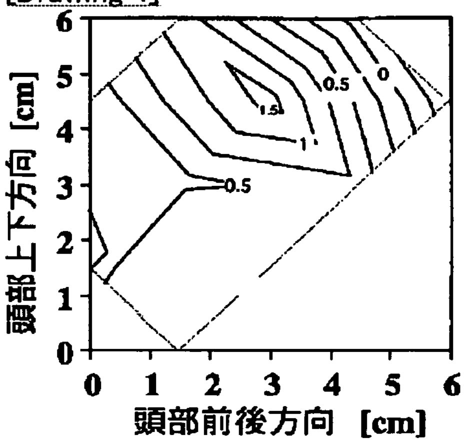
[Drawing 2]



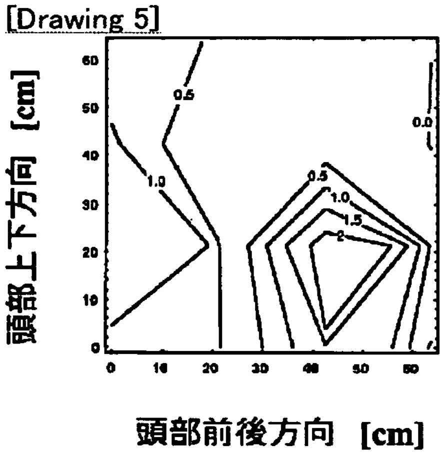
[Drawing 3]



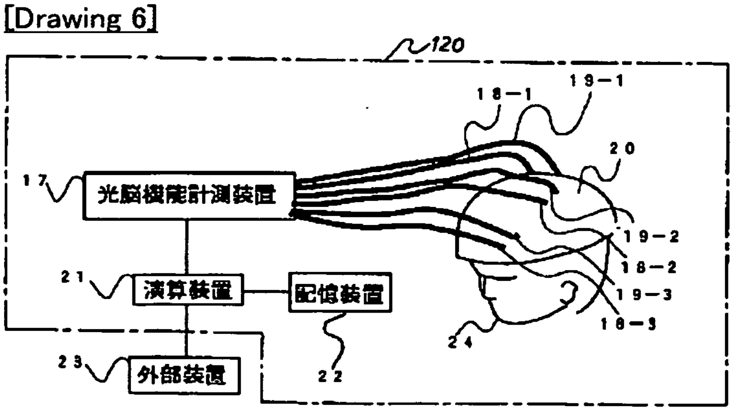
[Drawing 4]



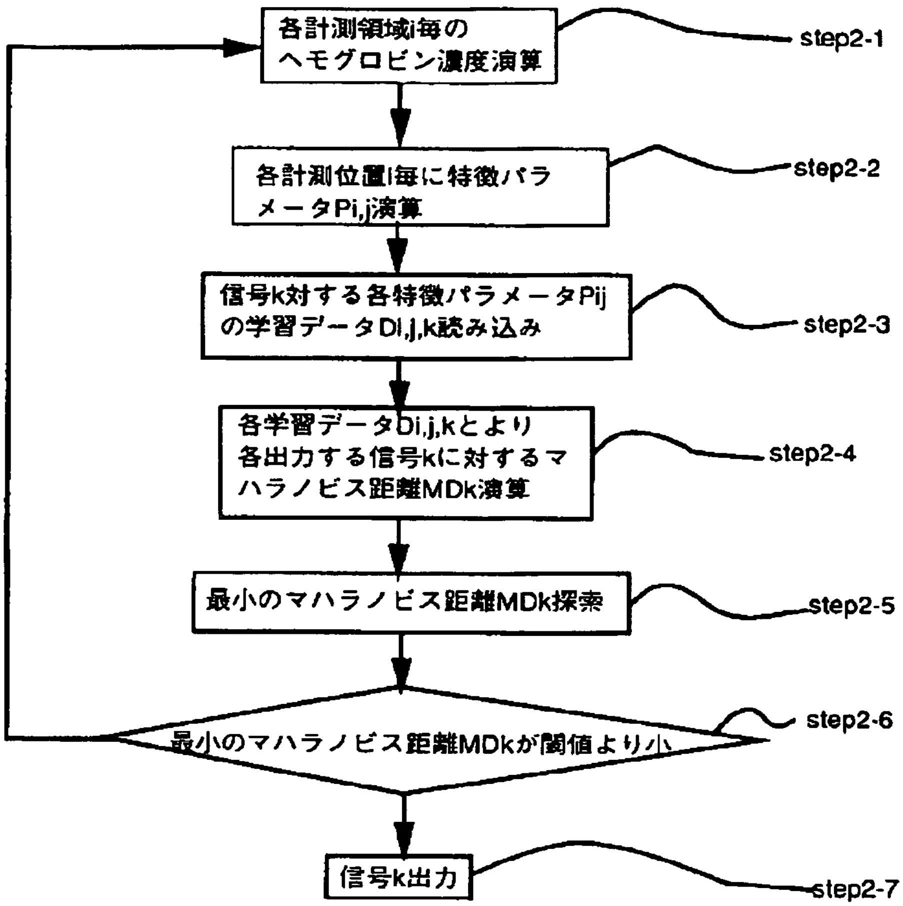
[Drawing 5]



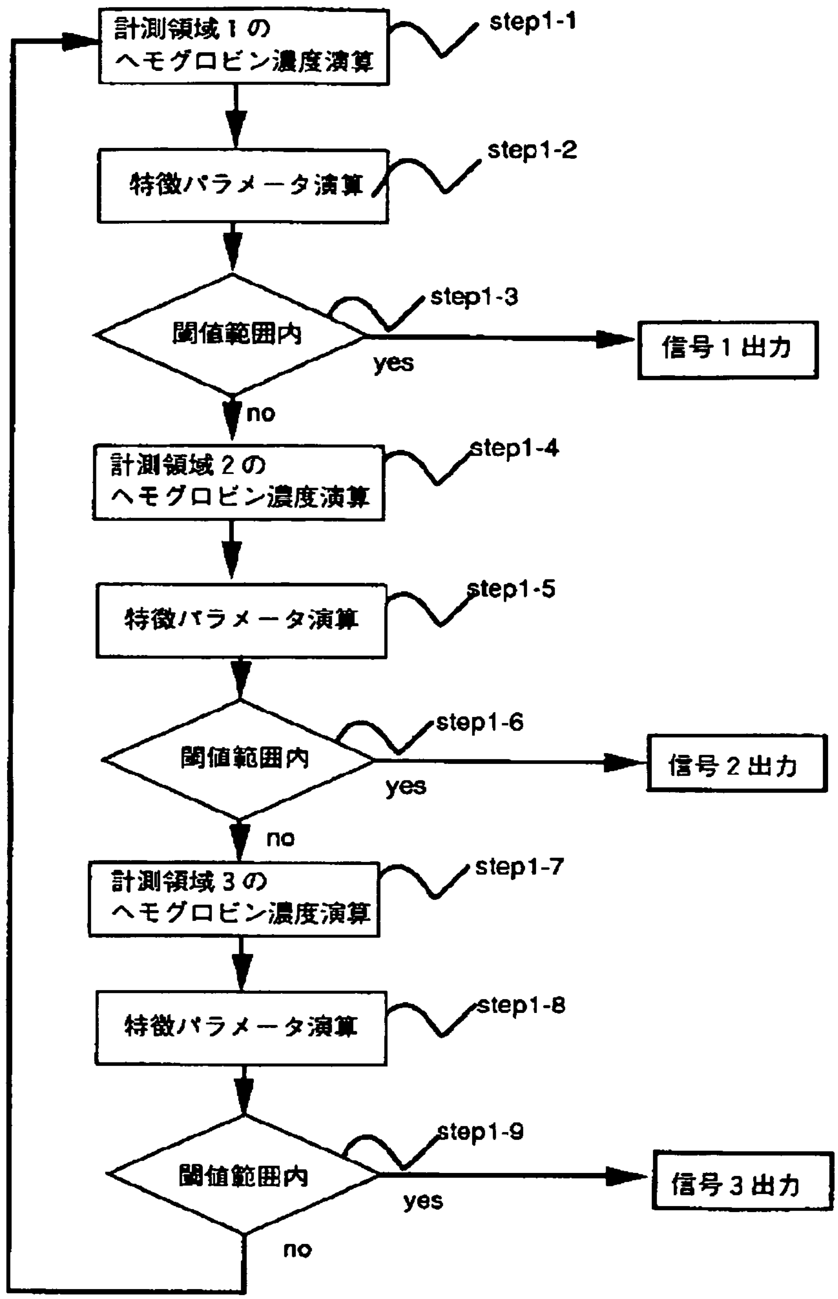
[Drawing 6]



[Drawing 8]


各計測領域i毎の
ヘモグロビン濃度演算
step2-1
各計測位置i毎に特徴パラ
メータPi,j演算
step2-2
信号k対する各特徴パラメータPij
の学習データDi,j,k読み込み
step2-3
各学習データDi,j,kとより
各出力する信号kに対するマ
ハラノビス距離MDk演算
step2-4
最小のマハラノビス距離MDk探索
step2-5
最小のマハラノビス距離MDkが閾値より小
step2-6
信号k出力
step2-7

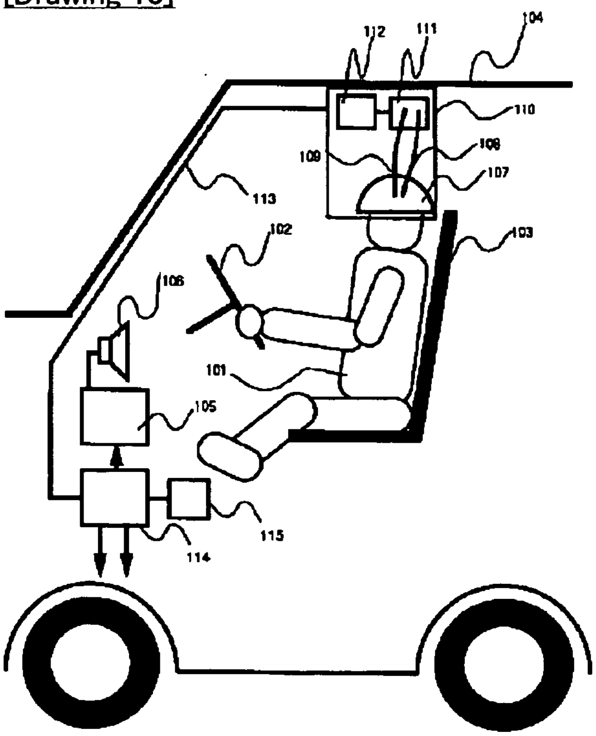
[Drawing 7]


計測領域１の
ヘモグロビン濃度演算
step1-1
特徴パラメータ演算
step1-2
閾値範囲内
step1-3
yes
信号１出力
no
計測領域２の
ヘモグロビン濃度演算
step1-4
特徴パラメータ演算
step1-5
閾値範囲内
step1-6
yes
信号２出力
no
計測領域３の
ヘモグロビン濃度演算
step1-7
特徴パラメータ演算
step1-8
閾値範囲内
step1-9
yes
信号３出力
no

[Drawing 9]

特徴パラメータ j / 計測領域 i	1	2	....	m−1	m
1	$S_{1,1,k}$ $A_{1,1,k}$	$S_{1,2,k}$ $A_{1,2,k}$	....	$S_{1,m-1,k}$ $A_{1,m-1,k}$	$S_{1,m,k}$ $A_{1,m,k}$
2	$S_{2,1,k}$ $A_{2,1,k}$	$S_{2,2,k}$ $A_{2,2,k}$	....	$S_{2,m-1,k}$ $A_{2,m-1,k}$	$S_{2,m,k}$ $A_{2,m,k}$
⋮	⋮	⋮	⋱	⋮	⋮
n−1	$S_{n-1,1,k}$ $A_{n-1,1,k}$	$S_{n-1,2,k}$ $A_{n-1,2,k}$	....	$S_{n-1,m-1,k}$ $A_{n-1,m-1,k}$	$S_{n-1,m,k}$ $A_{n-1,m,k}$
n	$S_{n,1,k}$ $A_{n,1,k}$	$S_{n,2,k}$ $A_{n,2,k}$	....	$S_{n,m-1,k}$ $A_{n,m-1,k}$	$S_{n,m,k}$ $A_{n,m,k}$

[Drawing 10]



[Translation done.]